



# FortiOS™ Handbook

## System Administration

**VERSION 5.2.0**

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Tuesday, September 01, 2015

FortiOS™ Handbook - System Administration

# TABLE OF CONTENTS

<b>Change Log</b>	<b>10</b>
<b>Introduction</b>	<b>11</b>
How this guide is organized	11
<b>Using the CLI</b>	<b>12</b>
Connecting to the CLI	12
Connecting to the CLI using a local console	12
Enabling access to the CLI through the network (SSH or Telnet)	13
Connecting to the CLI using SSH	14
Connecting to the CLI using Telnet	15
Connecting to the CLI locally with FortiExplorer	16
Command syntax	17
Terminology	17
Indentation	18
Notation	19
Sub-commands	20
Example of table commands	23
Permissions	24
Tips	25
Help	25
Shortcuts and key commands	25
Command abbreviation	26
Adding and removing options from lists	26
Environment variables	27
Special characters	27
Using grep to filter get and show command output	28
Language support and regular expressions	29
Screen paging	32
Baud rate	32
Editing the configuration file on an external host	32
Using Perl regular expressions	33
<b>Firmware</b>	<b>35</b>
Backing up the current configuration	35
Downloading firmware	35
Testing new firmware before installing	36

Upgrading the firmware - web-based manager.....	37
Upgrading the firmware - CLI.....	38
Installing firmware from a system reboot using the CLI.....	39
Reverting to a previous firmware version - web-based manager.....	41
Reverting to a previous firmware version - CLI.....	41
Configuration revision.....	42
Controlled upgrade.....	42
<b>Interfaces.....</b>	<b>44</b>
Physical.....	44
Interface settings.....	46
Interface configuration and settings.....	48
Software switch.....	52
Soft switch example.....	53
Virtual Switch.....	53
Loopback interfaces.....	54
Redundant interfaces.....	54
One-armed sniffer.....	55
Aggregate Interfaces.....	56
DHCP addressing mode on an interface.....	57
PPPoE addressing mode on an interface.....	59
Administrative access.....	60
Wireless.....	61
Interface MTU packet size.....	62
Secondary IP addresses to an interface.....	63
Virtual domains.....	63
Virtual LANs.....	64
Zones.....	65
Probing interfaces.....	67
<b>Central management.....</b>	<b>68</b>
Adding a FortiGate to FortiManager.....	68
FortiGate configuration.....	68
FortiManager configuration.....	70
Configuration through FortiManager.....	70
Global objects.....	70
Locking the FortiGate web-based manager.....	70
Firmware updates.....	71
FortiGuard.....	71
Backup and restore configurations.....	71
Administrative domains.....	72
<b>Monitoring.....</b>	<b>73</b>
Dashboard.....	73
Widgets.....	73

FortiClient software.....	74
sFlow.....	74
Configuration.....	75
Monitor menus.....	75
Logging.....	75
FortiCloud.....	76
FortiGate memory.....	76
FortiGate hard disk.....	77
Syslog server.....	77
FortiAnalyzer.....	77
Sending logs using a secure connection.....	78
Packet Capture.....	79
Alert email.....	80
SNMP.....	81
SNMP configuration settings.....	82
Gigabit interfaces.....	85
SNMP agent.....	85
SNMP community.....	86
Enabling on the interface.....	87
Fortinet MIBs.....	88
SNMP get command syntax.....	89
<b>VLANs.....</b>	<b>90</b>
VLAN ID rules.....	90
VLAN switching and routing.....	91
VLAN layer-2 switching.....	91
VLAN layer-3 routing.....	94
VLANs in NAT mode.....	98
Adding VLAN subinterfaces.....	99
Configuring security policies and routing.....	101
Example VLAN configuration in NAT mode.....	102
General configuration steps.....	103
Configure the FortiGate unit.....	103
Configure the VLAN switch.....	108
Test the configuration.....	109
VLANs in transparent mode.....	110
VLANs and transparent mode.....	110
Example of VLANs in transparent mode.....	112
General configuration steps.....	113
Configure the FortiGate unit.....	113
Configure the Cisco switch and router.....	117
Test the configuration.....	118
Troubleshooting VLAN issues.....	119

Asymmetric routing .....	119
Layer-2 and Arp traffic .....	119
Forward-domain solution .....	121
NetBIOS .....	122
STP forwarding .....	122
Too many VLAN interfaces .....	123
<b>PPTP and L2TP .....</b>	<b>124</b>
How PPTP VPNs work .....	124
FortiGate unit as a PPTP server .....	126
Configuring user authentication for PPTP clients .....	126
Enabling PPTP and specifying the PPTP IP address range .....	127
Adding the security policy .....	128
Configuring the FortiGate unit for PPTP VPN .....	129
Configuring the FortiGate unit for PPTP pass through .....	129
Configuring a virtual IP address .....	130
Configuring a port-forwarding security policy .....	130
Testing PPTP VPN connections .....	131
Logging VPN events .....	132
Configuring L2TP VPNs .....	132
Network topology .....	134
L2TP infrastructure requirements .....	134
L2TP configuration overview .....	134
Authenticating L2TP clients .....	135
Enabling L2TP and specifying an address range .....	135
Defining firewall source and destination addresses .....	135
Adding the security policy .....	136
Configuring a Linux client .....	137
Monitoring L2TP sessions .....	137
Testing L2TP VPN connections .....	137
Logging L2TP VPN events .....	137
<b>Session helpers .....</b>	<b>139</b>
Viewing the session helper configuration .....	139
Changing the session helper configuration .....	140
Changing the protocol or port that a session helper listens on .....	140
Disabling a session helper .....	141
DCE-RPC session helper (dcerpc) .....	143
DNS session helpers (dns-tcp and dns-udp) .....	143
File transfer protocol (FTP) session helper (ftp) .....	143
H.245 session helpers (h245I and h245O) .....	144
H.323 and RAS session helpers (h323 and ras) .....	144
Alternate H.323 gatekeepers .....	144
Media Gateway Controller Protocol (MGCP) session helper (mgcp) .....	144

ONC-RPC portmapper session helper (pmap).....	145
PPTP session helper for PPTP traffic (pptp).....	145
Remote shell session helper (rsh).....	146
Real-Time Streaming Protocol (RTSP) session helper (rtsp).....	147
Session Initiation Protocol (SIP) session helper (sip).....	147
Trivial File Transfer Protocol (TFTP) session helper (tftp).....	147
Oracle TNS listener session helper (tns).....	148
<b>Advanced concepts.....</b>	<b>149</b>
Dual internet connections (redundant Internet connections).....	149
Redundant interfaces.....	149
Load sharing.....	152
Link redundancy and load sharing.....	152
Single firewall vs. multiple virtual domains.....	153
Single firewall vs. vdoms.....	153
Modem.....	156
USB modem port.....	156
Modes.....	157
Additional modem configuration.....	159
Modem interface routing.....	159
FortiExtender.....	159
Installing the 3G/4G modem.....	159
Connecting the FortiExtender unit.....	159
Configuring the FortiExtender unit.....	160
Configuring the FortiGate unit.....	161
DHCP servers and relays.....	162
DHCP Server configuration.....	163
DHCP in IPv6.....	164
Service.....	164
Lease time.....	164
DHCP options.....	164
Exclude addresses in DHCP a range.....	165
DHCP Monitor.....	165
Breaking an address lease.....	165
Assigning IP address by MAC address.....	165
DNS services.....	166
DNS settings.....	166
Additional DNS CLI configuration.....	167
DNS server.....	167
Recursive DNS.....	168
Dynamic DNS.....	169
FortiClient discovery and registration.....	169
FortiClient discovery.....	169

FortiClient Registration .....	170
IP addresses for self-originated traffic .....	170
Administration for schools .....	171
Security policies .....	171
DNS .....	172
Encrypted traffic (HTTPS) .....	172
FTP .....	172
Example security policies .....	172
UTM security profiles .....	173
Logging .....	174
Replacement messages list .....	174
Replacement message images .....	175
Adding images to replacement messages .....	175
Modifying replacement messages .....	175
Alert Mail replacement messages .....	176
Authentication replacement messages .....	176
Captive Portal Default replacement messages .....	177
Device Detection Portal replacement message .....	177
Email replacement messages .....	177
Endpoint Control replacement message .....	177
FTP replacement messages .....	177
FortiGuard Web Filtering replacement messages .....	177
HTTP replacement messages .....	177
IM replacement messages .....	178
NNTP replacement messages .....	178
Spam replacement messages .....	178
NAC quarantine replacement messages .....	178
SSL VPN replacement message .....	178
Web Proxy replacement messages .....	178
Traffic quota control replacement messages .....	179
MM1 replacement messages .....	179
MM3 replacement messages .....	179
MM4 replacement messages .....	179
MM7 replacement messages .....	179
MMS replacement messages .....	179
Replacement message groups .....	179
Disk .....	180
Formatting the disk .....	180
Setting space quotas .....	180
CLI Scripts .....	180
Uploading script files .....	181
Rejecting PING requests .....	181



Opening TCP 113.....182

Obfuscate HTTP responses..... 182

## Change Log

Date	Change Description
2015-09-01	Added Firmware section
2015-08-29	Correction of number of minor editing errors

# Introduction

Welcome and thank you for selecting Fortinet products for your network protection.

This guide explains how to get started with a FortiGate unit, as well as examining basic configuration tasks, best practices, and more advanced configuration options.

## How this guide is organized

This guide contains the following sections:

[Using the CLI](#) provides an overview of the command line interface (CLI) for FortiOS. If you are new to the FortiOS CLI, this chapter provides a high level overview of how to use this method of administration.

[Interfaces](#) describes the FortiGate interface options and configuration choices.

[Central management](#) describes how to configure the FortiGate unit to use FortiManager as a method of maintaining the device and other features that FortiManager has to facilitate the administration of multiple devices.

[Monitoring](#) describes various methods of collecting log data and tracking traffic flows and trends.

[VLANs](#) discusses the implementation of virtual local area networks (VLANs) in FortiOS and how to configure and use them.

[PPTP and L2TP](#) describes these virtual private network (VPN) types and how to configure them.

[Session helpers](#) describes what session helpers are and how to view and configure them.

[Advanced concepts](#) describes more involved administrative topics to enhance network security and traffic efficiency.

# Using the CLI

The command line interface (CLI) is an alternative configuration tool to the web-based manager. While the configuration of the web-based manager uses a point-and-click method, the CLI requires typing commands or uploading batches of commands from a text file, like a configuration script.

This section also explains common CLI tasks that an administrator does on a regular basis and includes the topics:

- [Connecting to the CLI](#)
- [Command syntax](#)
- [Sub-commands](#)
- [Permissions](#)
- [Tips](#)

## Connecting to the CLI

You can access the CLI in three ways:

- Locally with a console cable — Connect your computer directly to the FortiGate unit's console port. Local access is required in some cases:
  - If you are installing your FortiGate unit for the first time and it is not yet configured to connect to your network, unless you reconfigure your computer's network settings for a peer connection, you may only be able to connect to the CLI using a local serial console connection.
  - Restoring the firmware utilizes a boot interrupt. Network access to the CLI is not available until after the boot process has completed, making local CLI access the only viable option.
- Through the network — Connect your computer through any network attached to one of the FortiGate unit's network ports. The network interface must have enabled Telnet or SSH administrative access if you will connect using an SSH/Telnet client, or HTTP/HTTPS administrative access if you will connect using the **CLI Console** widget in the web-based manager.
- Locally with FortiExplorer — Connect your computer directly to the FortiGate unit's USB management port. FortiExplorer provides direct access to the FortiOS setup wizard, Web-based Manager, and CLI console.

## Connecting to the CLI using a local console

Local console connections to the CLI are formed by directly connecting your management computer or console to the FortiGate unit, using its DB-9 or RJ-45 console port. To connect to the local console you need:

- A computer with an available serial communications (COM) port.
- The RJ-45-to-DB-9 or null modem cable included in your FortiGate package.
- Terminal emulation software such as HyperTerminal for Microsoft Windows.

The following procedure describes connection using Microsoft HyperTerminal software; steps may vary with other terminal emulators.

**To connect to the CLI using a local serial console connection**

1. Using the null modem or RJ-45-to-DB-9 cable, connect the FortiGate unit's console port to the serial communications (COM) port on your management computer.
2. On your management computer, start HyperTerminal.
3. For the **Connection Description**, enter a **Name** for the connection, and select **OK**.
4. On the **Connect using** drop-down list box, select the communications (COM) port on your management computer you are using to connect to the FortiGate unit.
5. Select **OK**.
6. Select the following **Port** settings and select **OK**.

<b>Bits per second</b>	9600
<b>Data bits</b>	8
<b>Parity</b>	None
<b>Stop bits</b>	1
<b>Flow control</b>	None

7. Press **Enter** or **Return** on your keyboard to connect to the CLI.
8. Type a valid administrator account name (such as `admin`) and press Enter.
9. Type the password for that administrator account and press Enter. (In its default state, there is no password for the `admin` account.)

The CLI displays the following text:

```
Welcome!
Type ? to list available commands.
```

You can now enter CLI commands, including configuring access to the CLI through SSH or Telnet.

**Enabling access to the CLI through the network (SSH or Telnet)**

SSH or Telnet access to the CLI is accomplished by connecting your computer to the FortiGate unit using one of its RJ-45 network ports. You can either connect directly, using a peer connection between the two, or through any intermediary network.



If you do not want to use an SSH/Telnet client and you have access to the web-based manager, you can alternatively access the CLI through the network using the **CLI Console** widget in the web-based manager.

You must enable SSH and/or Telnet on the network interface associated with that physical network port. If your computer is not connected directly or through a switch, you must also configure the FortiGate unit with a static route to a router that can forward packets from the FortiGate unit to your computer. You can do this using either a local console connection or the web-based manager.

## Requirements

- A computer with an available serial communications (COM) port and RJ-45 port
- Terminal emulation software such as HyperTerminal for Microsoft Windows
- The RJ-45-to-DB-9 or null modem cable included in your FortiGate package
- A network cable
- Prior configuration of the operating mode, network interface, and static route.

## To enable SSH or Telnet access to the CLI using a local console connection

1. Using the network cable, connect the FortiGate unit's network port either directly to your computer's network port, or to a network through which your computer can reach the FortiGate unit.
2. Note the number of the physical network port.
3. Using a local console connection, connect and log into the CLI.
4. Enter the following command:

```
config system interface
  edit <interface_str>
    set allowaccess <protocols_list>
  end
```

where:

- <interface\_str> is the name of the network interface associated with the physical network port and containing its number, such as `port1`
- <protocols\_list> is the complete, space-delimited list of permitted administrative access protocols, such as `https ssh telnet`

For example, to exclude HTTP, HTTPS, SNMP, and PING, and allow only SSH and Telnet administrative access on `port1`:

```
config system interface
  edit port1
    set allowaccess ssh telnet
  end
```

5. To confirm the configuration, enter the command to display the network interface's settings.

```
show system interface <interface_str>
```

The CLI displays the settings, including the allowed administrative access protocols, for the network interfaces.

## Connecting to the CLI using SSH

Once the FortiGate unit is configured to accept SSH connections, you can use an SSH client on your management computer to connect to the CLI.

Secure Shell (SSH) provides both secure authentication and secure communications to the CLI. FortiGate units support 3DES and Blowfish encryption algorithms for SSH.

Before you can connect to the CLI using SSH, you must first configure a network interface to accept SSH connections. The following procedure uses PuTTY. Steps may vary with other SSH clients.

### To connect to the CLI using SSH

1. On your management computer, start an SSH client.
2. In **Host Name (or IP Address)**, enter the IP address of a network interface on which you have enabled SSH administrative access.
3. In **Port**, enter `22`.
4. For the **Connection type**, select **SSH**.
5. Select **Open**.

The SSH client connects to the FortiGate unit.

The SSH client may display a warning if this is the first time you are connecting to the FortiGate unit and its SSH key is not yet recognized by your SSH client, or if you have previously connected to the FortiGate unit but used a different IP address or SSH key. This is normal. If your management computer is directly connected to the FortiGate unit with no network hosts between them.

6. Click **Yes** to verify the fingerprint and accept the FortiGate unit's SSH key. You will not be able to log in until you have accepted the key.
7. The CLI displays a login prompt.
8. Type a valid administrator account name (such as `admin`) and press Enter.
9. Type the password for this administrator account and press Enter.

The FortiGate unit displays a command prompt (its host name followed by a `#`). You can now enter CLI commands.



If three incorrect login or password attempts occur in a row, you will be disconnected. If this occurs, wait one minute, then reconnect to attempt the login again.

### Connecting to the CLI using Telnet

Once the FortiGate unit is configured to accept Telnet connections, you can use a Telnet client on your management computer to connect to the CLI.



Telnet is not a secure access method. SSH should be used to access the CLI from the Internet or any other untrusted network.

Before you can connect to the CLI using Telnet, you must first configure a network interface to accept Telnet connections.

### To connect to the CLI using Telnet

1. On your management computer, start a Telnet client.
2. Connect to a FortiGate network interface on which you have enabled Telnet.
3. Type a valid administrator account name (such as `admin`) and press Enter.
4. Type the password for this administrator account and press Enter.

The FortiGate unit displays a command prompt (its host name followed by a `#`). You can now enter CLI commands.



If three incorrect login or password attempts occur in a row, you will be disconnected. If this occurs, wait one minute, then reconnect to attempt the login again.

---

## Connecting to the CLI locally with FortiExplorer

FortiExplorer is a standalone software solution that allows you to connect to your FortiGate device using the USB interface of your management computer. FortiExplorer provides direct access to the FortiOS setup wizard, Web-based Manager, and CLI console.

FortiExplorer is available for download from the Customer Service & Support website <https://support.fortinet.com> in firmware images. FortiExplorer is available for both Microsoft Windows and Mac OS X computers.

FortiExplorer provides a user-friendly tool that you can use to configure a FortiGate unit over a standard USB connection, rather than using a console cable or Ethernet connection.



Do not connect the USB cable until after FortiExplorer has been installed.

---

### Installing FortiExplorer on Microsoft Windows

To install FortiExplorer on a Microsoft Windows workstation:

1. Double-click the .msi or .exe file and follow the instructions on-screen.
2. Connect the USB cable to the FortiGate unit and then to the management computer.
3. The FortiExplorer Fortinet Device Easy Configuration Utility opens when the USB cable is connected. Select **Install the hardware automatically** and select **Next**.
4. After a moment, FortiExplorer will launch.

### Installing FortiExplorer on Mac OS X

To install FortiExplorer on a Mac OS X workstation:

1. Double-click the .dmg file and drag the FortiExplorer program file into the Applications folder.
2. Connect the USB cable to the FortiGate unit and then to the management computer.
3. Double-click the FortiExplorer icon to launch the application.

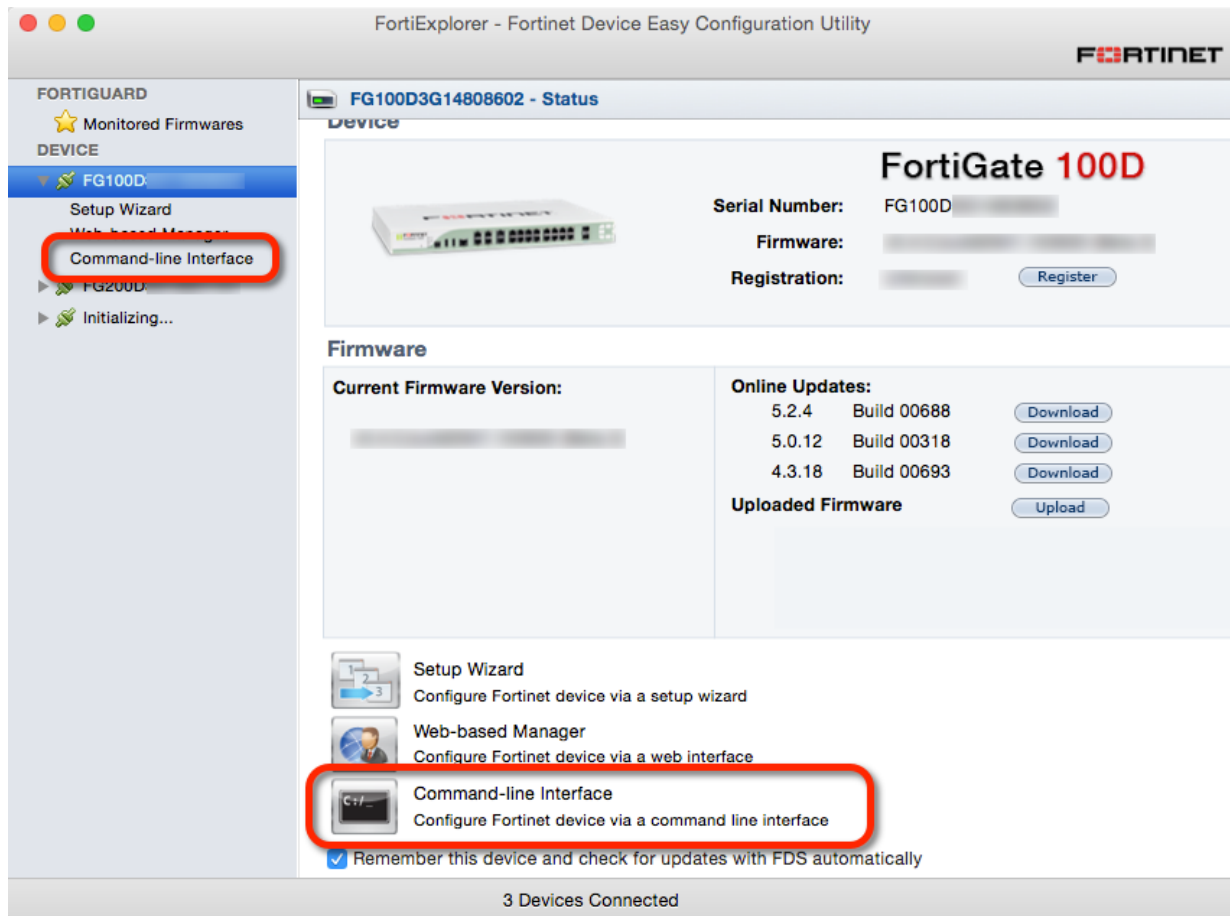
### Starting the CLI from FortiExplorer

The below image shows the FortiExplorer tool connected to a FortiGate 100D device. You have two options for connecting to the CLI.

1. The left window pan, in the **Devices** section, under the specific FortiGate's name, select on **Command-line Interface**. Select the text
2. In the main window pane, at the bottom, there is an icon of a terminal window beside the text **Command-line Interface**. Select the icon.

Selecting either of these links will open a terminal emulation or command line interface in the main window pane of the FortiExplorer window.





## Command syntax

When entering a command, the command line interface (CLI) requires that you use valid syntax and conform to expected input constraints. It will reject invalid commands.

Fortinet documentation uses the following conventions to describe valid command syntax

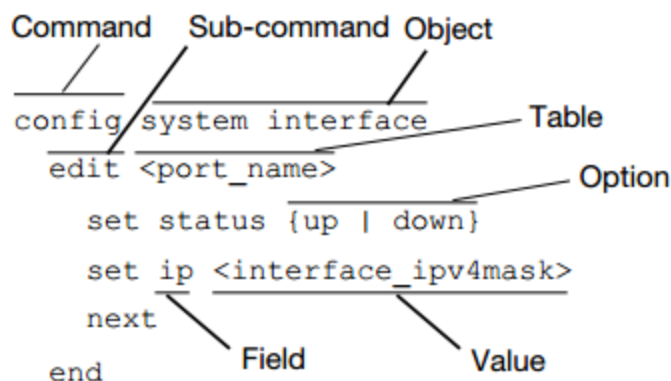
## Terminology

Each command line consists of a command word that is usually followed by words for the configuration data or other specific item that the command uses or affects:

```
get system admin
```

To describe the function of each word in the command line, especially if that nature has changed between firmware versions, Fortinet uses terms with the following definitions.

## Command syntax terminology



- **command** — A word that begins the command line and indicates an action that the FortiGate unit should perform on a part of the configuration or host on the network, such as `config` or `execute`. Together with other words, such as fields or values, that end when you press the Enter key, it forms a command line. Exceptions include multiline command lines, which can be entered using an escape sequence. Valid command lines must be unambiguous if abbreviated. Optional words or other command line permutations are indicated by syntax notation.
- **sub-command** — A kind of command that is available only when nested within the scope of another command. After entering a command, its applicable sub-commands are available to you until you exit the scope of the command, or until you descend an additional level into another sub-command. Indentation is used to indicate levels of nested commands. Not all top-level commands have sub-commands. Available sub-commands vary by their containing scope.
- **object** — A part of the configuration that contains tables and/or fields. Valid command lines must be specific enough to indicate an individual object.
- **table** — A set of fields that is one of possibly multiple similar sets which each have a name or number, such as an administrator account, policy, or network interface. These named or numbered sets are sometimes referenced by other parts of the configuration that use them.
- **field** — The name of a setting, such as `ip` or `hostname`. Fields in some tables must be configured with values. Failure to configure a required field will result in an invalid object configuration error message, and the FortiGate unit will discard the invalid table.
- **value** — A number, letter, IP address, or other type of input that is usually your configuration setting held by a field. Some commands, however, require multiple input values which may not be named but are simply entered in sequential order in the same command line. Valid input types are indicated by constraint notation.
- **option** — A kind of value that must be one or more words from of a fixed set of options.

## Indentation

Indentation indicates levels of nested commands, which indicate what other subcommittees are available from within the scope. For example, the `edit` sub-command is available only within a command that affects tables, and the `next` sub-command is available only from within the `edit` sub-command:

```
config system interface
  edit port1
    set status up
  end
```

## Notation

Brackets, braces, and pipes are used to denote valid permutations of the syntax. Constraint notations, such as `<address_ipv4>`, indicate which data types or string patterns are acceptable value input.

### Command syntax notation

Convention	Description
<b>Square brackets</b> <code>[ ]</code>	<p>A non-required word or series of words. For example:</p> <pre>[verbose {1   2   3}]</pre> <p>indicates that you may either omit or type both the <code>verbose</code> word and its accompanying option, such as <code>verbose 3</code>.</p>
<b>Angle brackets</b> <code>&lt; &gt;</code>	<p>A word constrained by data type. The angled brackets contain a descriptive name followed by an underscore ( <code>_</code> ) and suffix that indicates the valid data type. For example, <code>&lt;retries_int&gt;</code>, indicates that you should enter a number of retries, such as 5.</p> <p>Data types include:</p> <ul style="list-style-type: none"> <li>• <code>&lt;xxx_name&gt;</code>: A name referring to another part of the configuration, such as <code>policy_A</code>.</li> <li>• <code>&lt;xxx_index&gt;</code>: An index number referring to another part of the configuration, such as 0 for the first static route.</li> <li>• <code>&lt;xxx_pattern&gt;</code>: A regular expression or word with wild cards that matches possible variations, such as <code>*@example.com</code> to match all email addresses ending in <code>@example.com</code>.</li> <li>• <code>&lt;xxx_fqdn&gt;</code>: A fully qualified domain name (FQDN), such as <code>mail.example.com</code>.</li> <li>• <code>&lt;xxx_email&gt;</code>: An email address, such as <code>admin@example.com</code>.</li> <li>• <code>&lt;xxx_ipv4&gt;</code>: An IPv4 address, such as <code>192.168.1.99</code>.</li> <li>• <code>&lt;xxx_v4mask&gt;</code>: A dotted decimal IPv4 netmask, such as <code>255.255.255.0</code>.</li> <li>• <code>&lt;xxx_ipv4mask&gt;</code>: A dotted decimal IPv4 address and netmask separated by a space, such as <code>192.168.1.99 255.255.255.0</code>.</li> <li>• <code>&lt;xxx_ipv4/mask&gt;</code>: A dotted decimal IPv4 address and CIDR-notation netmask separated by a slash, such as <code>192.168.1.1/24</code></li> <li>• <code>&lt;xxx_ipv4range&gt;</code> : A hyphen ( <code>-</code> )-delimited inclusive range of IPv4 addresses, such as <code>192.168.1.1-192.168.1.255</code>.</li> <li>• <code>&lt;xxx_ipv6&gt;</code>: A colon ( <code>:</code> )-delimited hexadecimal IPv6 address, such as <code>3f2e:6a8b:78a3:0d82:1725:6a2f:0370:6234</code>.</li> <li>• <code>&lt;xxx_v6mask&gt;</code>: An IPv6 netmask, such as <code>/96</code>.</li> </ul>

Convention	Description
	<ul style="list-style-type: none"> <li>• <code>&lt;xxx_ipv6mask&gt;</code>: A dotted decimal IPv6 address and netmask separated by a space.</li> <li>• <code>&lt;xxx_str&gt;</code>: A string of characters that is not another data type, such as <code>P@ssw0rd</code>. Strings containing spaces or special characters must be surrounded in quotes or use escape sequences.</li> <li>• <code>&lt;xxx_int&gt;</code>: An integer number that is <b>not</b> another data type, such as <code>15</code> for the number of minutes.</li> </ul>
<b>Curly braces</b> { }	A word or series of words that is constrained to a set of options delimited by either vertical bars or spaces. You must enter at least one of the options, unless the set of options is surrounded by square brackets [ ].
<b>Options delimited by vertical bars</b>	<p>Mutually exclusive options. For example:</p> <pre>{enable   disable}</pre> <p>indicates that you must enter either <code>enable</code> or <code>disable</code>, but must not enter both.</p>
<b>Options delimited by spaces</b>	<p>Non-mutually exclusive options. For example:</p> <pre>{http https ping snmp ssh telnet}</pre> <p>indicates that you may enter all or a subset of those options, in any order, in a space-delimited list, such as:</p> <pre>ping https ssh</pre>

## Sub-commands

Each command line consists of a command word that is usually followed by words for the configuration data or other specific item that the command uses or affects:

```
get system admin
```

Sub-commands are available from within the scope of some commands. When you enter a sub-command level, the command prompt changes to indicate the name of the current command scope. For example, after entering:

```
config system admin
```

the command prompt becomes:

```
(admin) #
```

Applicable sub-commands are available to you until you exit the scope of the command, or until you descend an additional level into another sub-command.

For example, the `edit` sub-command is available only within a command that affects tables; the `next` sub-command is available only from within the `edit` sub-command:

```

config system interface
  edit port1
    set status up
  next
end

```

Sub-command scope is indicated by indentation.

Available sub-commands vary by command. From a command prompt within `config`, two types of sub-commands might become available:

- commands affecting fields
- commands affecting tables

### Commands for tables

#### **clone <table>**

Clone (or make a copy of) a table from the current object.

For example, in `config firewall policy`, you could enter the following command to clone security policy 27 to create security policy 30:

```
clone 27 to 30
```

In `config antivirus profile`, you could enter the following command to clone an antivirus profile named `av_pro_1` to create a new antivirus profile named `av_pro_2`:

```
clone av_pro_1 to av_pro_2
```

`clone` may not be available for all tables.

#### **delete <table>**

Remove a table from the current object.

For example, in `config system admin`, you could delete an administrator account named `newadmin` by typing `delete newadmin` and pressing Enter. This deletes `newadmin` and all its fields, such as `newadmin's` first-name and email-address.

`delete` is only available within objects containing tables.

**edit <table>**

Create or edit a table in the current object.

For example, in `config system admin`:

- edit the settings for the default `admin` administrator account by typing `edit admin`.
- add a new administrator account with the name `newadmin` and edit `newadmin`'s settings by typing `edit newadmin`.

`edit` is an interactive sub-command: further sub-commands are available from within `edit`.

`edit` changes the prompt to reflect the table you are currently editing.

`edit` is only available within objects containing tables.

In objects such as security policies, `<table>` is a sequence number. To create a new entry without the risk of overwriting an existing one, enter `edit 0`. The CLI initially confirms the creation of entry 0, but assigns the next unused number after you finish editing and enter `end`.

**end**

Save the changes to the current object and exit the `config` command. This returns you to the top-level command prompt.

**get**

List the configuration of the current object or table.

- In objects, `get` lists the table names (if present), or fields and their values.
- In a table, `get` lists the fields and their values.

For more information on `get` commands, see the [CLI Reference](#).

**purge**

Remove all tables in the current object.

For example, in `config user local`, you could type `get` to see the list of user names, then type `purge` and then `y` to confirm that you want to delete all users.

`purge` is only available for objects containing tables.

**Caution:** Back up the FortiGate unit before performing a `purge`. `purge` cannot be undone. To restore purged tables, the configuration must be restored from a backup.

**Caution:** Do not purge `system interface` or `system admin` tables. `purge` does not provide default tables. This can result in being unable to connect or log in, requiring the FortiGate unit to be formatted and restored.

<b>rename &lt;table&gt; to &lt;table&gt;</b>	<p>Rename a table.</p> <p>For example, in <code>config system admin</code>, you could rename <code>admin3</code> to <code>fwadmin</code> by typing <code>rename admin3 to fwadmin</code>.</p> <p><code>rename</code> is only available within objects containing tables.</p>
<b>show</b>	Display changes to the default configuration. Changes are listed in the form of configuration commands.

## Example of table commands

From within the `system admin` object, you might enter:

```
edit admin_1
```

The CLI acknowledges the new table, and changes the command prompt to show that you are now within the `admin_1` table:

```
new entry 'admin_1' added
(admin_1) #
```

## Commands for fields

<b>abort</b>	Exit both the <code>edit</code> and/or <code>config</code> commands without saving the fields.
<b>append</b>	Add an option to an existing list.
<b>end</b>	Save the changes made to the current table or object fields, and exit the <code>config</code> command. (To exit without saving, use <code>abort</code> instead.)
<b>get</b>	<p>List the configuration of the current object or table.</p> <ul style="list-style-type: none"> <li>• In objects, <code>get</code> lists the table names (if present), or fields and their values.</li> <li>• In a table, <code>get</code> lists the fields and their values.</li> </ul>
<b>move</b>	Move an object within a list, when list order is important. For example, rearranging security policies within the policy list.
<b>next</b>	<p>Save the changes you have made in the current table's fields, and exit the <code>edit</code> command to the object prompt. (To save and exit completely to the root prompt, use <code>end</code> instead.)</p> <p><code>next</code> is useful when you want to create or edit several tables in the same object, without leaving and re-entering the <code>config</code> command each time.</p> <p><code>next</code> is only available from a table prompt; it is not available from an object prompt.</p>

<b>select</b>	Clear all options except for those specified.  For example, if a group contains members A, B, C, and D and you remove all users except for B, use the command <code>select member B</code> .
<b>set &lt;field&gt; &lt;value&gt;</b>	Set a field's value.  For example, in <code>config system admin</code> , after typing <code>edit admin</code> , you could type <code>set password newpass</code> to change the password of the <code>admin</code> administrator to <code>newpass</code> .  <b>Note:</b> When using <code>set</code> to change a field containing a space-delimited list, type the whole new list. For example, <code>set &lt;field&gt; &lt;new-value&gt;</code> will replace the list with the <code>&lt;new-value&gt;</code> rather than appending <code>&lt;new-value&gt;</code> to the list.
<b>show</b>	Display changes to the default configuration. Changes are listed in the form of configuration commands.
<b>unselect</b>	Remove an option from an existing list.
<b>unset &lt;field&gt;</b>	Reset the table or object's fields to default values.  For example, in <code>config system admin</code> , after typing <code>edit admin</code> , typing <code>unset password</code> resets the password of the <code>admin</code> administrator account to the default (in this case, no password).

### Example of field commands

From within the `admin_1` table, you might enter:

```
set password my1stExamplePassword
```

to assign the value `my1stExamplePassword` to the `password` field. You might then enter the `next` command to save the changes and edit the next administrator's table.

## Permissions

Depending on the account that you use to log in to the FortiGate unit, you may not have complete access to all CLI commands. Access profiles control which CLI commands an administrator account can access. Access profiles assign either read, write, or no access to each area of the FortiGate software. To view configurations, you must have read access. To make changes, you must have write access.

Unlike other administrator accounts, the administrator account named `admin` exists by default and cannot be deleted. The `admin` administrator account is similar to a root administrator account. This administrator account always has full permission to view and change all FortiGate configuration options, including viewing and changing **all** other administrator accounts. Its name and permissions cannot be changed. It is the only administrator account that can reset another administrator's password without being required to enter that administrator's existing password.





Set a strong password for the admin administrator account, and change the password regularly. By default, this administrator account has no password. Failure to maintain the password of the admin administrator account could compromise the security of your FortiGate unit.

For complete access to all commands, you must log in with the administrator account named `admin`.

## Tips

Basic features and characteristics of the CLI environment provide support and ease of use for many CLI tasks.

## Help

To display brief help during command entry, press the question mark (?) key.

- Press the question mark (?) key at the command prompt to display a list of the commands available and a description of each command.
- Type a word or part of a word, then press the question mark (?) key to display a list of valid word completions or subsequent words, and to display a description of each.

## Shortcuts and key commands

### Shortcuts and key commands

Action	Keys
List valid word completions or subsequent words.  If multiple words could complete your entry, display all possible completions with helpful descriptions of each.	?
Complete the word with the next available match.  Press the key multiple times to cycle through available matches.	Tab
Recall the previous command.  Command memory is limited to the current session.	Up arrow, or Ctrl + P
Recall the next command.	Down arrow, or Ctrl + N
Move the cursor left or right within the command line.	Left or Right arrow
Move the cursor to the beginning of the command line.	Ctrl + A

Action	Keys
Move the cursor to the end of the command line.	Ctrl + E
Move the cursor backwards one word.	Ctrl + B
Move the cursor forwards one word.	Ctrl + F
Delete the current character.	Ctrl + D
Abort current interactive commands, such as when entering multiple lines.	Ctrl + C
If you are not currently within an interactive command such as <code>config</code> or <code>edit</code> , this closes the CLI connection.	
Continue typing a command on the next line for a multi-line command.	
For each line that you want to continue, terminate it with a backslash (\). To complete the command line, terminate it by pressing the spacebar and then the Enter key, without an immediately preceding backslash.	

## Command abbreviation

You can abbreviate words in the command line to their smallest number of non-ambiguous characters.

For example, the command `get system status` could be abbreviated to `g sy stat`.

## Adding and removing options from lists

When adding options to a list, such as a user group, using the `set` command will remove the previous configuration. For example, if you wish to add user D to a user group that already contains members A, B, and C, the command would need to be `set member A B C D`. If only `set member D` was used, then all former members would be removed from the group.

However, there are additional commands which can be used instead of `set` for changing options in a list.

### Additional commands for lists

<b>append</b>	Add an option to an existing list.  For example, <code>append member</code> would add user D to a user group while all previous group members are retained
<b>select</b>	Clear all options except for those specified.  For example, if a group contains members A, B, C, and D and you remove all users except for B, use the command <code>select member B</code> .

<b>unselect</b>	Remove an option from an existing list.
	For example, <code>unselect member A</code> would remove member A from a group will all previous group members are retained.

## Environment variables

The CLI supports the following environment variables. Variable names are case-sensitive.

### Environment variables

<b>\$USERFROM</b>	The management access type ( <code>ssh</code> , <code>telnet</code> , <code>jsconsole</code> for the <b>CLI Console</b> widget in the web-based manager, and so on) and the IP address of the administrator that configured the item.
<b>\$USERNAME</b>	The account name of the administrator that configured the item.
<b>\$SerialNum</b>	The serial number of the FortiGate unit.

For example, the FortiGate unit's host name can be set to its serial number.

```
config system global
    set hostname $SerialNum
end
```

## Special characters

The characters `<`, `>`, `(`, `)`, `#`, `'`, and `"` are not permitted in most CLI fields. These characters are special characters, also known as reserved characters.

You may be able to enter special character as part of a string's value by using a special command, enclosing it in quotes, or preceding it with an escape sequence — in this case, a backslash (`\`) character.

In other cases, different keystrokes are required to input a special character. If you need to enter `?` as part of config, you first need to input CTRL-V. If you enter the question mark (`?`) without first using CTRL-V, the question mark has a different meaning in CLI: it will show available command options in that section.

For example, if you enter `?` without CTRL-V:

```
edit "*.xe
token line: Unmatched double quote.
```

If you enter `?` with CTRL-V:

```
edit "*.xe?"
new entry '*.xe?' added
```

### Entering special characters

Character	Keys
?	Ctrl + V then ?
Tab	Ctrl + V then Tab
Space (to be interpreted as part of a string value, not to end the string)	<p>Enclose the string in quotation marks: "Security Administrator".</p> <p>Enclose the string in single quotes: 'Security Administrator'.</p> <p>Precede the space with a backslash: Security\ Administrator.</p>
' (to be interpreted as part of a string value, not to end the string)	\'
" (to be interpreted as part of a string value, not to end the string)	\"
\	\\

### Using grep to filter get and show command output

In many cases, the `get` and `show` (and `diagnose`) commands may produce a large amount of output. If you are looking for specific information in a large `get` or `show` command output, you can use the `grep` command to filter the output to only display what you are looking for. The `grep` command is based on the standard UNIX `grep`, used for searching text output based on regular expressions.

Use the following command to display the MAC address of the FortiGate unit internal interface:

```
get hardware nic internal | grep Current_HWaddr
Current_HWaddr           00:09:0f:cb:c2:75
```

Use the following command to display all TCP sessions in the session list and include the session list line number in the output

```
get system session list | grep -n tcp
```

Use the following command to display all lines in HTTP replacement message commands that contain URL (upper or lower case):

```
show system replacemsg http | grep -i url
```

There are three additional options that can be applied to `grep`:

```
-A <num> After  
-B <num> Before  
-C <num> Context
```

The option `-f` is also available to support Fortinet contextual output, in order to show the complete configuration. The following example shows the difference in output when `-f` option is used versus when it is not.

### Using `-f`:

```
show | grep -f ldap-group1  
config user group  
  edit "ldap-group1"  
    set member "pc40-LDAP"  
  next  
end  
config firewall policy  
  edit 2  
    set srcintf "port31"  
    set dstintf "port32"  
    set srcaddr "all"  
    set action accept  
    set identity-based enable  
    set nat enable  
    config identity-based-policy  
      edit 1  
        set schedule "always"  
        set groups "ldap-group1"  
        set dstaddr "all"  
        set service "ALL"  
      next  
    end  
  next  
end
```

### Without using `-f`:

```
show | grep ldap-group1  
  edit "ldap-group1"  
    set groups "ldap-group1"
```

## Language support and regular expressions

Characters such as ñ, é, symbols, and ideographs are sometimes acceptable input. Support varies by the nature of the item being configured. CLI commands, objects, field names, and options must use their exact ASCII characters, but some items with arbitrary names or values may be input using your language of choice. To use other languages in those cases, you must use the correct encoding.

Input is stored using Unicode UTF-8 encoding but is not normalized from other encodings into UTF-8 before it is stored. If your input method encodes some characters differently than in UTF-8, your configured items may not display or operate as expected.

Regular expressions are especially impacted. Matching uses the UTF-8 character values. If you enter a regular expression using another encoding, or if an HTTP client sends a request in an encoding other than UTF-8, matches may not be what you expect.

For example, with Shift-JIS, backslashes ( \ ) could be inadvertently interpreted as the symbol for the Japanese yen ( ¥ ) and vice versa. A regular expression intended to match HTTP requests containing money values with a yen symbol therefore may not work if the symbol is entered using the wrong encoding.

For best results, you should:

- use UTF-8 encoding, or
- use only the characters whose numerically encoded values are the same in UTF-8, such as the US-ASCII characters that are also encoded using the same values in ISO 8859-1, Windows code page 1252, Shift-JIS and other encodings, or
- for regular expressions that must match HTTP requests, use the same encoding as your HTTP clients.



HTTP clients may send requests in encodings other than UTF-8. Encodings usually vary by the client's operating system or input language. If you cannot predict the client's encoding, you may only be able to match any parts of the request that are in English, because regardless of the encoding, the values for English characters tend to be encoded identically. For example, English words may be legible regardless of interpreting a web page as either ISO 8859-1 or as GB2312, whereas simplified Chinese characters might only be legible if the page is interpreted as GB2312.

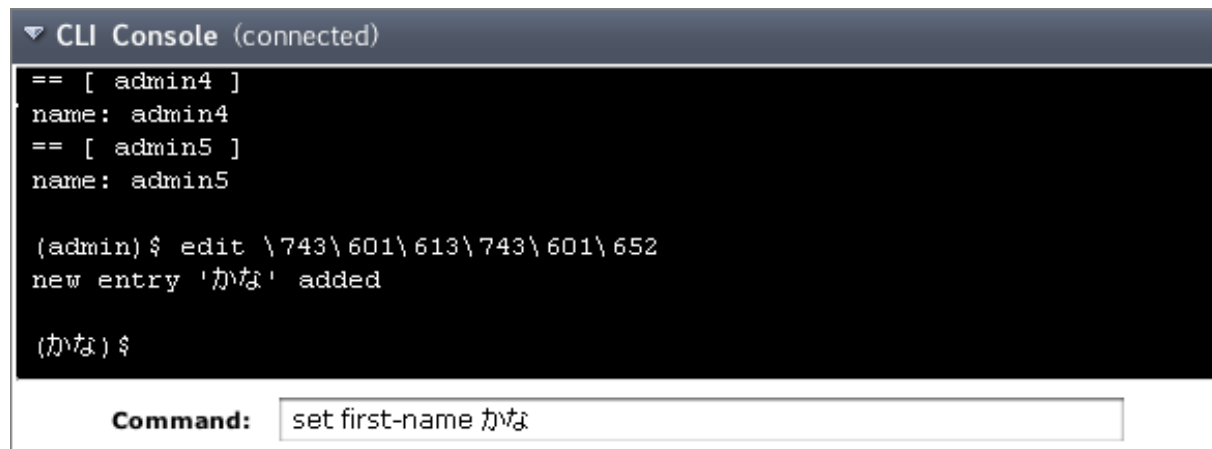
If you configure your FortiGate unit using other encodings, you may need to switch language settings on your management computer, including for your web browser or Telnet/SSH client. For instructions on how to configure your management computer's operating system language, locale, or input method, see its documentation.

If you choose to configure parts of the FortiGate unit using non-ASCII characters, verify that all systems interacting with the FortiGate unit also support the same encodings. You should also use the same encoding throughout the configuration if possible in order to avoid needing to switch the language settings of the web-based manager and your web browser or Telnet/SSH client while you work.

Similarly to input, your web browser or CLI client should usually interpret display output as encoded using UTF-8. If it does not, your configured items may not display correctly in the web-based manager or CLI. Exceptions include items such as regular expressions that you may have configured using other encodings in order to match the encoding of HTTP requests that the FortiGate unit receives.

### To enter non-ASCII characters in the CLI Console widget

1. On your management computer, start your web browser and go to the URL for the FortiGate unit's web-based manager.
2. Configure your web browser to interpret the page as UTF-8 encoded.
3. Log in to the FortiGate unit.
4. Go to **System > Dashboard > Status**.
5. In title bar of the **CLI Console** widget, click **Edit** (the pencil icon).
6. Enable **Use external command input box**.
7. Select **OK**.
8. The **Command** field appears below the usual input and display area of the **CLI Console** widget.
9. In **Command**, type a command.

**Entering encoded characters (CLI Console widget):****10. Press Enter.**

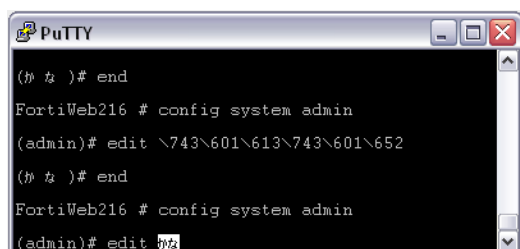
In the display area, the **CLI Console** widget displays your previous command interpreted into its character code equivalent, such as:

```
edit \743\601\613\743\601\652
```

and the command's output.

**To enter non-ASCII characters in a Telnet/SSH client**

1. On your management computer, start your Telnet or SSH client.
2. Configure your Telnet or SSH client to send and receive characters using UTF-8 encoding.  
Support for sending and receiving international characters varies by each Telnet/SSH client. Consult the documentation for your Telnet/SSH client.
3. Log in to the FortiGate unit.
4. At the command prompt, type your command and press Enter.

**Entering encoded characters (PuTTY):**

You may need to surround words that use encoded characters with single quotes ( ' ).

Depending on your Telnet/SSH client's support for your language's input methods and for sending international characters, you may need to interpret them into character codes before pressing Enter.

For example, you might need to enter:

```
edit '\743\601\613\743\601\652'
```

5. The CLI displays your previous command and its output.

## Screen paging

You can configure the CLI to pause after displaying each page's worth of text when displaying multiple pages of output. When the display pauses, the last line displays `--More--`. You can then either:

- press the spacebar to display the next page.
- type `Q` to truncate the output and return to the command prompt.

This may be useful when displaying lengthy output, such as the list of possible matching commands for command completion, or a long list of settings. Rather than scrolling through or possibly exceeding the buffer of your terminal emulator, you can simply display one page at a time.

To configure the CLI display to pause when the screen is full:

```
config system console
  set output more
end
```

## Baud rate

You can change the default baud rate of the local console connection.

To change the baud rate enter the following commands:

```
config system console
  set baudrate {115200 | 19200 | 38400 | 57600 | 9600}
end
```

## Editing the configuration file on an external host

You can edit the FortiGate configuration on an external host by first backing up the configuration file to a TFTP server. Then edit the configuration file and restore it to the FortiGate unit.

Editing the configuration on an external host can be timesaving if you have many changes to make, especially if your plain text editor provides advanced features such as batch changes.

### To edit the configuration on your computer

1. Use `execute backup` to download the configuration file to a TFTP server, such as your management computer.
2. Edit the configuration file using a plain text editor that supports Unix-style line endings.



Do not edit the first line. The first line(s) of the configuration file (preceded by a `#` character) contains information about the firmware version and FortiGate model. If you change the model number, the FortiGate unit will reject the configuration file when you attempt to restore it.

3. Use `execute restore` to upload the modified configuration file back to the FortiGate unit. The FortiGate unit downloads the configuration file and checks that the model information is correct. If it is, the FortiGate unit loads the configuration file and checks each command for errors. If a



command is invalid, the FortiGate unit ignores the command. If the configuration file is valid, the FortiGate unit restarts and loads the new configuration.

## Using Perl regular expressions

Some FortiGate features, such as spam filtering and web content filtering can use either wildcards or Perl regular expressions.

See <http://perldoc.perl.org/perlretut.html> for detailed information about using Perl regular expressions. For more information on using Perl expressions see the Security Profiles chapter of The Handbook.

### Differences between regular expression and wildcard pattern matching

In Perl regular expressions, the period (‘.’) character refers to any single character. It is similar to the question mark (‘?’) character in wildcard pattern matching. As a result:

- `fortinet.com` not only matches `example.com` but also matches `exampleacom`, `examplebcom`, `exampleccom` and so on.

To match a special character such as the period (‘.’) and the asterisk (‘\*’), regular expressions use the slash (‘\’) escape character. For example:

- To match `example.com`, the regular expression should be `example\.com`.

In Perl regular expressions, the asterisk (‘\*’) means match 0 or more times of the character before it, not 0 or more times of any character. For example:

- `exam*\ .com` matches `exammmmm.com` but does not match `eample.com`.

To match any character 0 or more times, use ‘.\*’ where ‘.’ means any character and the ‘\*’ means 0 or more times. For example:

- the wildcard match pattern `exam* .com` is equivalent to the regular expression `exam.*\ .com`.

### Word boundary

In Perl regular expressions, the pattern does not have an implicit word boundary. For example, the regular expression “test” not only matches the word “test” but also matches any word that contains the word “test” such as “atest”, “mytest”, “testimony”, “atestb”. The notation “\b” specifies the word boundary. To match exactly the word “test”, the expression should be `\btest\b`.

### Case sensitivity

Regular expression pattern matching is case sensitive in the Web and Spam filters. To make a word or phrase case insensitive, use the regular expression `/i`. For example, `/bad language/i` will block all instances of “bad language” regardless of case.

### Perl regular expression examples

Expression	Matches
<code>abc</code>	<code>abc</code> (that exact character sequence, but anywhere in the string)

Expression	Matches
<b>^abc</b>	abc at the beginning of the string
<b>abc\$</b>	abc at the end of the string
<b>a b</b>	either of a and b
<b>^abc abc\$</b>	the string abc at the beginning or at the end of the string
<b>ab{2,4}c</b>	an a followed by two, three or four b's followed by a c
<b>ab{2,}c</b>	an a followed by at least two b's followed by a c
<b>ab*c</b>	an a followed by any number (zero or more) of b's followed by a c
<b>ab+c</b>	an a followed by one or more b's followed by a c
<b>ab?c</b>	an a followed by an optional b followed by a c; that is, either abc or ac
<b>a.c</b>	an a followed by any single character (not newline) followed by a c
<b>a\.c</b>	a.c exactly
<b>[abc]</b>	any one of a, b and c
<b>[Aa]bc</b>	either of Abc and abc
<b>[abc]+</b>	any (nonempty) string of a's, b's and c's (such as a, abba, acbabcacaa)
<b>[^abc]+</b>	any (nonempty) string which does not contain any of a, b and c (such as defg)
<b>\d\d</b>	any two decimal digits, such as 42; same as <b>\d{2}</b>
<b>/i</b>	makes the pattern case insensitive. For example, <b>/bad language/i</b> blocks any instance of "bad language" regardless of case.
<b>\w+</b>	a "word": a nonempty sequence of alphanumeric characters and low lines (underscores), such as foo and 12bar8 and foo_1
<b>100\s*mk</b>	the strings 100 and mk optionally separated by any amount of white space (spaces, tabs, newlines)
<b>abc\b</b>	abc when followed by a word boundary (e.g. in abc! but not in abcd)
<b>perl\B</b>	perl when not followed by a word boundary (e.g. in perlert but not in perl stuff)
<b>\x</b>	tells the regular expression parser to ignore white space that is neither backslashed nor within a character class. You can use this to break up your regular expression into (slightly) more readable parts.

# Firmware

Fortinet periodically updates the FortiGate firmware to include new features and resolve important issues. After you have registered your FortiGate unit, you can download firmware updates from the support web site, <https://support.fortinet.com>.

Before you install any new firmware, be sure to follow the steps below:

- Review the Release Notes for a new firmware release.
- Review the Supported Upgrade Paths document to make sure the upgrade from your current image to the desired new image is supported.
- Backup the current configuration, including local certificates. For more information, see [Firmware on page 35](#).
- Test the new firmware until you are satisfied that it applies to your configuration.

Installing new firmware without reviewing release notes or testing the firmware may result in changes to settings or unexpected issues.

Only FortiGate admin users and administrators whose access profiles contain system read and write privileges can change the FortiGate firmware.

## Backing up the current configuration

In case you need to restore your FortiGate configuration, you should always back up the configuration before installing new firmware.

**To create a local backup:**

1. Go to **System > Dashboard > Status** and locate the **System Information** widget.
2. Select **Backup** beside **System Configuration**.
3. Choose either **Local PC** or **USB Disk** to save the configuration file.
4. If desired, select **Encrypt configuration file**.
5. Select **Backup**.

## Downloading firmware

Firmware images for all FortiGate units is available on the Fortinet Customer Support website, <https://support.fortinet.com>.

**To download firmware**

1. Log into the site using your user name and password.
2. Go to **Download > Firmware Images**.
3. A list of Release Notes is shown. If you have not already done so, download and review the Release Notes for the firmware you wish to upgrade your FortiGate unit to.
4. Select **HTTPS Download**.



Firmware can also be downloaded using FTP; however, as FTP is not an encrypted file transferring protocol, HTTPS downloading is recommended.

---

5. Navigate to find the folder for the firmware version you wish to use.
6. Select your FortiGate model from the list. If your unit is a FortiWiFi, be sure to get the appropriate firmware, which will have a filename starting with FWF.
7. Save the firmware image to your computer.

## Testing new firmware before installing

FortiOS enables you to test a new firmware image by installing the firmware image from a system reboot and saving it to system memory. After completing this procedure, the FortiGate unit operates using the new firmware image with the current configuration. This new firmware image is not permanently installed. The next time the FortiGate unit restarts, it operates with the originally installed firmware image using the current configuration. If the new firmware image operates successfully, you can install it permanently using the procedure [Testing new firmware before installing on page 36](#).

To use this procedure, you must connect to the CLI using the FortiGate console port and a RJ-45 to DB-9 or null modem cable. This procedure temporarily installs a new firmware image using your current configuration.

For this procedure, you must install a TFTP server that you can connect to from the FortiGate internal interface. The TFTP server should be on the same subnet as the internal interface.

### To test the new firmware image

1. Connect to the CLI using a RJ-45 to DB-9 or null modem cable.
2. Make sure the TFTP server is running.
3. Copy the new firmware image file to the root directory of the TFTP server.
4. Make sure the FortiGate unit can connect to the TFTP server using the `execute ping` command.
5. Enter the following command to restart the FortiGate unit:  

```
execute reboot
```
6. As the FortiGate unit reboots, press any key to interrupt the system startup. As the FortiGate unit starts, a series of system startup messages appears.  
When the following messages appears:  

```
Press any key to display configuration menu....
```
7. Immediately press any key to interrupt the system startup.



You have only 3 seconds to press any key. If you do not press a key soon enough, the FortiGate unit reboots and you must login and repeat the `execute reboot` command.

---

If you successfully interrupt the startup process, the following messages appears:

```
[G]: Get firmware image from TFTP server.
```

```
[F]: Format boot device.  
[B]: Boot with backup firmware and set as default  
[C]: Configuration and information  
[Q]: Quit menu and continue to boot with default firmware.  
[H]: Display this list of options.  
Enter G, F, Q, or H:
```

8. Type **G** to get the new firmware image from the TFTP server.

The following message appears:

```
Enter TFTP server address [192.168.1.168]:
```

9. Type the address of the TFTP server and press **Enter**.

The following message appears:

```
Enter Local Address [192.168.1.188]:
```

10. Type an IP address of the FortiGate unit to connect to the TFTP server.

The IP address must be on the same network as the TFTP server.



Make sure you do not enter the IP address of another device on this network.

---

The following message appears:

```
Enter File Name [image.out]:
```

11. Enter the firmware image file name and press **Enter**.

The TFTP server uploads the firmware image file to the FortiGate unit and the following appears.

```
Save as Default firmware/Backup firmware/Run image without saving: [D/B/R]
```

12. Type **R**.

The FortiGate image is installed to system memory and the FortiGate unit starts running the new firmware image, but with its current configuration.

You can test the new firmware image as required. When done testing, you can reboot the FortiGate unit, and the FortiGate unit will resume using the firmware that was running before you installed the test firmware.

## Upgrading the firmware - web-based manager

Installing firmware replaces your current antivirus and attack definitions, along with the definitions included with the firmware release you are installing. After you install new firmware, make sure that antivirus and attack definitions are up to date.



Always remember to back up your configuration before making any changes to the firmware.

### To upgrade the firmware

1. Log into the web-based manager as the admin administrative user.
2. Go to **System > Dashboard > Status** and locate the **System Information** widget.
3. Beside **Firmware Version**, select **Update**.
4. Type the path and filename of the firmware image file, or select **Browse** and locate the file.
5. Select **OK**.

The FortiGate unit uploads the firmware image file, upgrades to the new firmware version, restarts, and displays the FortiGate login. This process takes a few minutes.

## Upgrading the firmware - CLI

Installing firmware replaces your current antivirus and attack definitions, along with the definitions included with the firmware release you are installing. After you install new firmware, make sure that antivirus and attack definitions are up to date. You can also use the CLI command `execute update-now` to update the antivirus and attack definitions. For more information, see the System Administration handbook.

Before you begin, ensure you have a TFTP server running and accessible to the FortiGate unit.



Always remember to back up your configuration before making any changes to the firmware.

### To upgrade the firmware using the CLI

1. Make sure the TFTP server is running.
2. Copy the new firmware image file to the root directory of the TFTP server.
3. Log into the CLI.
4. Make sure the FortiGate unit can connect to the TFTP server.

You can use the following command to ping the computer running the TFTP server. For example, if the IP address of the TFTP server is 192.168.1.168:

```
execute ping 192.168.1.168
```

5. Enter the following command to copy the firmware image from the TFTP server to the FortiGate unit:

```
execute restore image tftp <filename> <tftp_ipv4>
```

Where `<name_str>` is the name of the firmware image file and `<tftp_ip4>` is the IP address of the TFTP server. For example, if the firmware image file name is `image.out` and the IP address of the TFTP server is 192.168.1.168, enter:

```
execute restore image tftp image.out 192.168.1.168
```

The FortiGate unit responds with the message:

```
This operation will replace the current firmware version!  
Do you want to continue? (y/n)
```

6. Type `y`.
7. The FortiGate unit uploads the firmware image file, upgrades to the new firmware version, and restarts. This process takes a few minutes.
8. Reconnect to the CLI.
9. Update antivirus and attack definitions, by entering:  

```
execute update-now
```

## Installing firmware from a system reboot using the CLI

There is a possibility that the firmware upgrade does not load properly and the FortiGate unit will not boot, or continuously reboots. If this occurs, it is best to perform a fresh install of the firmware from a reboot using the CLI.

This procedure installs a firmware image and resets the FortiGate unit to default settings. You can use this procedure to upgrade to a new firmware version, revert to an older firmware version, or re-install the current firmware.

To use this procedure, you must connect to the CLI using the FortiGate console port and a RJ-45 to DB-9, or null modem cable. This procedure reverts the FortiGate unit to its factory default configuration.

For this procedure you install a TFTP server that you can connect to from the FortiGate internal interface. The TFTP server should be on the same subnet as the internal interface.

Before beginning this procedure, ensure you back up the FortiGate unit configuration.

If you are reverting to a previous FortiOS version, you might not be able to restore the previous configuration from the backup configuration file.

Installing firmware replaces your current antivirus and attack definitions, along with the definitions included with the firmware release you are installing. After you install new firmware, make sure that antivirus and attack definitions are up to date.

### To install firmware from a system reboot

1. Connect to the CLI using the RJ-45 to DB-9 or null modem cable.
2. Make sure the TFTP server is running.
3. Copy the new firmware image file to the root directory of the TFTP server.
4. Make sure the internal interface is connected to the same network as the TFTP server.
5. To confirm the FortiGate unit can connect to the TFTP server, use the following command to ping the computer running the TFTP server. For example, if the IP address of the TFTP server is 192.168.1.168:

```
execute ping 192.168.1.168
```

6. Enter the following command to restart the FortiGate unit.

```
execute reboot
```

The FortiGate unit responds with the following message:

```
This operation will reboot the system!  
Do you want to continue? (y/n)
```

7. Type `y`.

As the FortiGate unit starts, a series of system startup messages appears. When the following messages appears:

Press any key to display configuration menu.....

Immediately press any key to interrupt the system startup.



You have only 3 seconds to press any key. If you do not press a key soon enough, the FortiGate unit reboots and you must log in and repeat the execute reboot command.

---

If you successfully interrupt the startup process, the following messages appears:

```
[G]: Get firmware image from TFTP server.  
[F]: Format boot device.  
[B]: Boot with backup firmware and set as default  
[C]: Configuration and information  
[Q]: Quit menu and continue to boot with default firmware.  
[H]: Display this list of options.  
Enter G, F, Q, or H:
```

8. Type **G** to get to the new firmware image form the TFTP server.

The following message appears:

```
Enter TFTP server address [192.168.1.168]:
```

9. Type the address of the TFTP server and press **Enter**.

The following message appears:

```
Enter Local Address [192.168.1.188]:
```

10. Type an IP address the FortiGate unit can use to connect to the TFTP server. The IP address can be any IP address that is valid for the network the interface is connected to.



Make sure you do not enter the IP address of another device on this network.

---

The following message appears:

```
Enter File Name [image.out]:
```

11. Enter the firmware image filename and press **Enter**.

The TFTP server uploads the firmware image file to the FortiGate unit and a message similar to the following appears:

```
Save as Default firmware/Backup firmware/Run image without saving: [D/B/R]
```

12. Type **D**.

The FortiGate unit installs the new firmware image and restarts. The installation might take a few minutes to complete.



## Reverting to a previous firmware version - web-based manager

The following procedures revert the FortiGate unit to its factory default configuration and deletes any configuration settings. If you are reverting to a previous FortiOS version, you might not be able to restore the previous configuration from the backup configuration file.



Always remember to back up your configuration before making any changes to the firmware.

### To revert to a previous firmware version

1. Go to **System > Dashboard > Status** and locate the **System Information widget**.
2. Beside **Firmware Version**, select **Update**.
3. Type the path and filename of the firmware image file, or select **Browse** and locate the file.
4. Select **OK**.

The FortiGate unit uploads the firmware image file, reverts to the old firmware version, resets the configuration, restarts, and displays the FortiGate login. This process takes a few minutes.

## Reverting to a previous firmware version - CLI

This procedure reverts the FortiGate unit to its factory default configuration and deletes IPS custom signatures, web content lists, email filtering lists, and changes to replacement messages.

Before beginning this procedure, it is recommended that you:

- back up the FortiGate unit system configuration using the command  
`execute backup config`
- back up the IPS custom signatures using the command `execute backup ipsuserdefsig`
- back up web content and email filtering lists

To use the following procedure, you must have a TFTP server the FortiGate unit can connect to.

### To revert to a previous firmware version using the CLI

1. Make sure the TFTP server is running
2. Copy the firmware image file to the root directory of the TFTP server.
3. Log into the FortiGate CLI.
4. Make sure the FortiGate unit can connect to the TFTP server execute by using the `execute ping` command.
5. Enter the following command to copy the firmware image from the TFTP server to the FortiGate unit:

```
execute restore image tftp <name_str> <tftp_ipv4>
```

Where `<name_str>` is the name of the firmware image file and `<tftp_ipv4>` is the IP address of the TFTP server. For example, if the firmware image file name is `imagev28.out` and the IP address of the TFTP server is `192.168.1.168`, enter:

```
execute restore image tftp image28.out 192.168.1.168
```

The FortiGate unit responds with this message:

```
This operation will replace the current firmware version!  
Do you want to continue? (y/n)
```

6. Type **y**.

The FortiGate unit uploads the firmware image file. After the file uploads, a message similar to the following appears:

```
Get image from tftp server OK.  
Check image OK.  
This operation will downgrade the current firmware version!  
Do you want to continue? (y/n)
```

7. Type **y**.

8. The FortiGate unit reverts to the old firmware version, resets the configuration to factory defaults, and restarts. This process takes a few minutes.

9. Reconnect to the CLI.

10. To restore your previous configuration, if needed, use the command:

```
execute restore config <name_str> <tftp_ip4>
```

11. Update antivirus and attack definitions using the command:

```
execute update-now.
```

## Configuration revision

The **Configuration Revisions** menu enables you to manage multiple versions of configuration files on models that have a 512 flash memory and higher. Revision control requires either a configured central management server or the local hard drive. The central management server can either be a FortiManager unit or FortiCloud.

If central management is not configured on your FortiGate unit, a message appears to tell you to do one of the following:

- enable central management
- obtain a valid license.

When revision control is enabled on your FortiGate unit, and configurations backups have been made, a list of saved revisions of those backed-up configurations appears.

Configuration revisions are viewed in the **System Information** widget on the Dashboard.

## Controlled upgrade

Using a controlled upgrade, you can upload a new version of the FortiOS firmware to a separate partition in the FortiGate memory for later upgrade. The FortiGate unit can also be configured so that when it is rebooted, it will automatically load the new firmware (CLI only). Using this option, you can stage a number of FortiGate units to do an upgrade simultaneously to all devices using FortiManager or script.

### To load the firmware for later installation - web-based manager

1. Go to **System > Dashboard > Status**.
2. Under **System Information > Firmware Version**, select **Update**.
3. Type the path and filename of the firmware image file, or select **Browse** and locate the file.
4. Deselect the **Boot the New Firmware** option.
5. Select **OK**.

**To load the firmware for later installation - CLI**

```
execute restore secondary-image {ftp | tftp | usb}
```

To set the FortiGate unit so that when it reboots, the new firmware is loaded, use the CLI command...

```
execute set-next-reboot {primary | secondary}
```

... where {primary | secondary} is the partition with the preloaded firmware.

**To trigger the upgrade using the web-based manager**

1. Go to **System > Dashboard > Status**.
2. Under **System Information > Firmware Version**, select **Details**.
3. Select the check box for the new firmware version.  
The **Comments** column indicates which firmware version is the current active version.
4. Select **Upgrade** icon.

# Interfaces

Interfaces, both physical and virtual, enable traffic to flow to and from the internal network, and the Internet and between internal networks. The FortiGate unit has a number of options for setting up interfaces and groupings of subnetworks that can scale to a company's growing requirements.

This chapter includes:

- Physical
- Interface settings
- Software switch
- Virtual Switch
- Loopback interfaces
- Redundant interfaces
- One-armed sniffer
- Aggregate Interfaces
- DHCP addressing mode on an interface
- Administrative access
- Wireless
- Interface MTU packet size
- Secondary IP addresses to an interface
- Virtual domains
- Virtual LANs
- Zones

## Physical

FortiGate units have a number of physical ports where you connect ethernet or optical cables. Depending on the model, they can have anywhere from four to 40 physical ports. Some units have a grouping of ports labelled as internal, providing a built-in switch functionality.

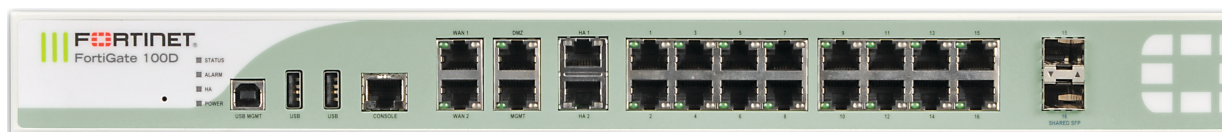
In FortiOS, the port names, as labeled on the FortiGate unit, appear in the web-based manager in the **Unit Operation** widget, found on the Dashboard. They also appear when you are configuring the interfaces, by going to **System > Network > Interface**. As shown below, the FortiGate-100D (Generation 2) has 22 interfaces.



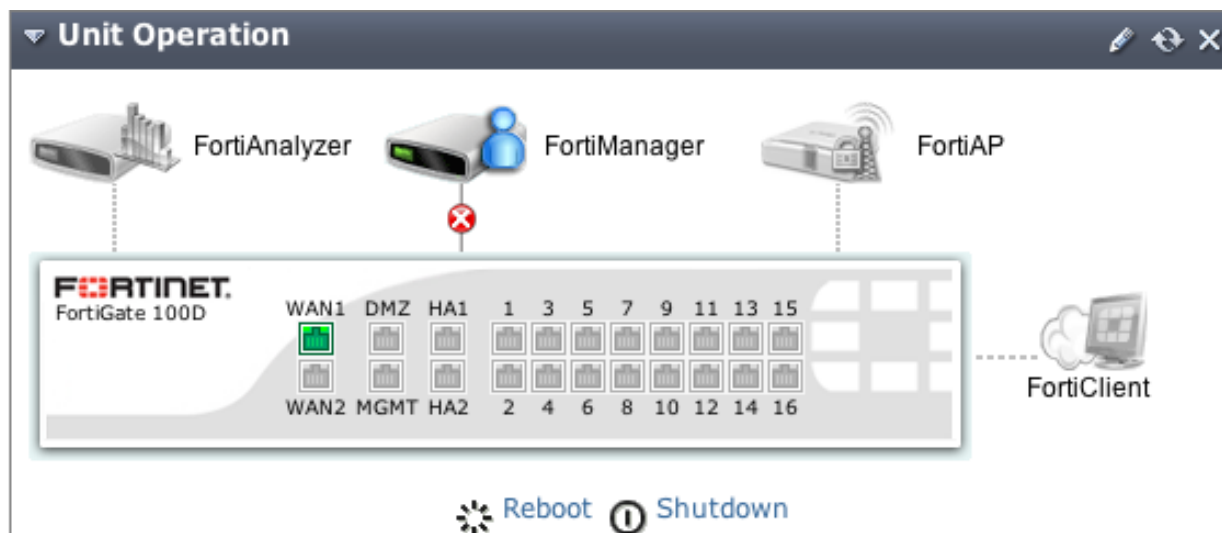
Two of the physical ports on the FortiGate-100D (Generation 2) are SFP ports. These ports share the numbers 15 and 16 with RJ-45 ports. Because of this, when SFP port 15 is used, RJ-45 port 15 cannot be used, and vice versa.

These ports also share the same MAC address.

## FortiGate-100D physical interfaces



## FortiGate-100D interfaces on the Dashboard



## Configuring the FortiGate-100D ports

Name	Type	IP/Netmask	Access	Administrative Status	Link Status	Ref.
<input type="checkbox"/> wan1	Physical	172.20.120.230 / 255.255.255.0	HTTP,HTTPS,PING,SSH	<span style="color: green;">⬆</span>	<span style="color: green;">⬆</span> 100 Mbps/Full Duplex	<a href="#">1</a>
<input type="checkbox"/> dmz	Physical	10.10.10.1 / 255.255.255.0	HTTPS,PING,FMG-Access	<span style="color: green;">⬆</span>	<span style="color: red;">⬆</span>	<a href="#">1</a>
<input type="checkbox"/> modem	Physical	0.0.0.0 / 0.0.0.0		<span style="color: red;">⬆</span>	<span style="color: red;">⬆</span>	<a href="#">0</a>
<input type="checkbox"/> wan2	Physical	0.0.0.0 / 0.0.0.0	PING,FMG-Access	<span style="color: green;">⬆</span>	<span style="color: red;">⬆</span>	<a href="#">1</a>
<input type="checkbox"/> mgmt	Physical	192.168.1.99 / 255.255.255.0	HTTPS,PING,FMG-Access	<span style="color: green;">⬆</span>	<span style="color: red;">⬆</span>	<a href="#">0</a>
<input type="checkbox"/> ha1	Physical	0.0.0.0 / 0.0.0.0		<span style="color: green;">⬆</span>	<span style="color: red;">⬆</span>	<a href="#">0</a>
<input type="checkbox"/> ha2	Physical	0.0.0.0 / 0.0.0.0		<span style="color: green;">⬆</span>	<span style="color: red;">⬆</span>	<a href="#">0</a>
<input type="checkbox"/> internal	Physical	192.168.100.99 / 255.255.255.0	HTTPS,PING,FMG-Access	<span style="color: green;">⬆</span>	<span style="color: green;">⬆</span> 100 Mbps/Full Duplex	<a href="#">3</a>

Normally the internal interface is configured as a single interface shared by all physical interface connections - a switch. The switch mode feature has two states - switch mode and interface mode. Switch mode is the default mode with only one interface and one address for the entire internal switch. Interface mode enables you to configure each of the internal switch physical interface connections separately. This enables you to assign different subnets and netmasks to each of the internal physical interface connections.

The larger FortiGate units can also include Advanced Mezzanine Cards (AMC), which can provide additional interfaces (Ethernet or optical), with throughput enhancements for more efficient handling of specialized traffic. These interfaces appear in FortiOS as port amc/sw1, amc/sw2 and so on. In the following illustration, the FortiGate-3810A has three AMC cards installed: two single-width (amc/sw1, amc/sw2) and one double-width (amc/dw).

## FortiGate-3810A AMC card port naming

<input type="checkbox"/>	Name	IP/Netmask	Access	Administrative Status	Link Status
<input type="checkbox"/>	amc-dw2/1	0.0.0.0 / 0.0.0.0			
<input type="checkbox"/>	amc-dw2/2	0.0.0.0 / 0.0.0.0			
<input type="checkbox"/>	amc-sw1/1	0.0.0.0 / 0.0.0.0			
<input type="checkbox"/>	amc-sw1/2	0.0.0.0 / 0.0.0.0			
<input type="checkbox"/>	amc-sw1/3	0.0.0.0 / 0.0.0.0			
<input type="checkbox"/>	amc-sw1/4	0.0.0.0 / 0.0.0.0			
<input type="checkbox"/>	amc-sw2/1	0.0.0.0 / 0.0.0.0			
<input type="checkbox"/>	amc-sw2/2	0.0.0.0 / 0.0.0.0			
<input type="checkbox"/>	amc-sw2/3	0.0.0.0 / 0.0.0.0			
<input type="checkbox"/>	amc-sw2/4	0.0.0.0 / 0.0.0.0			
<input type="checkbox"/>	april	0.0.0.0 / 0.0.0.0			
<input type="checkbox"/>	port1	10.21.101.101 / 255.255.255.0	HTTPS,PING,SSH		
<input type="checkbox"/>	port2	192.168.100.99 / 255.255.255.0	PING		
<input type="checkbox"/>	port3	0.0.0.0 / 0.0.0.0	PING		
<input type="checkbox"/>	port4	0.0.0.0 / 0.0.0.0	PING		
<input type="checkbox"/>	port5	0.0.0.0 / 0.0.0.0	PING		
<input type="checkbox"/>	port6	0.0.0.0 / 0.0.0.0	PING		
<input type="checkbox"/>	port7	0.0.0.0 / 0.0.0.0	PING		
<input type="checkbox"/>	port8	0.0.0.0 / 0.0.0.0	PING		
<input type="checkbox"/>	port9	0.0.0.0 / 0.0.0.0	PING		
<input type="checkbox"/>	port10	0.0.0.0 / 0.0.0.0	PING		

## Interface settings

In **System > Network > Interface**, you configure the interfaces, physical and virtual, for the FortiGate unit. There are different options for configuring interfaces when the FortiGate unit is in NAT mode or transparent mode. On FortiOS Carrier, you can also enable the Gi gatekeeper on each interface for anti-overbilling.

## Interface page

## Create New

Select to add a new interface, zone or, in transparent mode, port pair.

For more information on configuring zones, see [Zones](#).

Depending on the model you can add a VLAN interface, a loopback interface, a IEEE 802.3ad aggregated interface, or a redundant interface.

When VDOMs are enabled, you can also add Inter-VDOM links.

## Interface page

<b>Name</b>	<p>The names of the physical interfaces on your FortiGate unit. This includes any alias names that have been configured.</p> <p>When you combine several interfaces into an aggregate or redundant interface, only the aggregate or redundant interface is listed, not the component interfaces.</p> <p>If you have added VLAN interfaces, they also appear in the name list, below the physical or aggregated interface to which they have been added.</p> <p>If you have added loopback interfaces, they also appear in the interface list, below the physical interface to which they have been added. If you have software switch interfaces configured, you will be able to view them. If your FortiGate unit supports AMC modules, the interfaces are named amc-sw1/1, amc-dw1/2, and so on.</p>
<b>Type</b>	The configuration type for the interface.
<b>IP/Netmask</b>	<p>The current IP address and netmask of the interface.</p> <p>In VDOM, when VDOMs are not all in NAT or transparent mode some values may not be available for display and will be displayed as “-”.</p>
<b>Access</b>	The administrative access configuration for the interface.
<b>Administrative Status</b>	<p>Indicates if the interface can be accessed for administrative purposes. If the administrative status is a green arrow, and administrator could connect to the interface using the configured access.</p> <p>If the administrative status is a red arrow, the interface is administratively down and cannot be accessed for administrative purposes.</p>
<b>Link Status</b>	<p>The status of the interface physical connection. Link status can be either up (green arrow) or down (red arrow). If link status is up the interface is connected to the network and accepting traffic. If link status is down the interface is not connected to the network or there is a problem with the connection. You cannot change link status from the web-based manager, and typically is indicative of an ethernet cable plugged into the interface.</p> <p>Link status is only displayed for physical interfaces.</p>
<b>MAC</b>	The MAC address of the interface.
<b>Mode</b>	Shows the addressing mode of the interface. The addressing mode can be manual, DHCP, or PPPoE.
<b>Secondary IP</b>	Displays the secondary IP addresses added to the interface.

Interface page	
<b>MTU</b>	The maximum number of bytes per transmission unit (MTU) for the interface.
<b>Virtual Domain</b>	The virtual domain to which the interface belongs. This column is visible when VDOM configuration is enabled.
<b>VLAN ID</b>	The configured VLAN ID for VLAN subinterfaces.

## Interface configuration and settings

To configure an interface, go to **System > Network > Interface** and select **Create New**.

<b>Name</b>	Enter a name of the interface. Physical interface names cannot be changed.
<b>Alias</b>	<p>Enter an alternate name for a physical interface on the FortiGate unit. This field appears when editing an existing physical interface.</p> <p>The alias can be a maximum of 25 characters. The alias name will not appear in logs.</p>
<b>Link Status</b>	Indicates whether the interface is connected to a network (link status is <b>Up</b> ) or not (link status is <b>Down</b> ). This field appears when editing an existing physical interface.
<b>Type</b>	<p>Select the type of interface that you want to add.</p> <p>On some models you can set <b>Type</b> to <b>802.3ad Aggregate</b> or <b>Redundant Interface</b>.</p>
<b>Interface</b>	<p>Displayed when <b>Type</b> is set to <b>VLAN</b>.</p> <p>Select the name of the physical interface to which to add a VLAN interface. Once created, the VLAN interface is listed below its physical interface in the Interface list.</p> <p>You cannot change the physical interface of a VLAN interface except when adding a new VLAN interface.</p>
<b>VLAN ID</b>	<p>Displayed when <b>Type</b> is set to <b>VLAN</b>.</p> <p>Enter the VLAN ID. You cannot change the <b>VLAN ID</b> except when adding a new VLAN interface.</p> <p>The VLAN ID can be any number between 1 and 4094 and must match the VLAN ID added by the IEEE 802.1Q-compliant router or switch connected to the VLAN subinterface.</p>



<b>Virtual Domain</b>	<p>Select the virtual domain to add the interface to.</p> <p>Admin accounts with super_admin profile can change the <b>Virtual Domain</b>.</p>
<b>Physical Interface Members</b>	<p>This section has two different forms depending on the interface type:</p> <ul style="list-style-type: none"> <li>• <b>Software switch interface</b> - this section is a display-only field showing the interfaces that belong to the software switch virtual interface.</li> <li>• <b>802.3ad aggregate or Redundant interface</b> - this section includes available interface and selected interface lists to enable adding or removing interfaces from the interface.</li> </ul> <p>Select interfaces from this <b>Available Interfaces</b> list and select the right arrow to add an interface to the <b>Selected Interface</b> list.</p>
<b>Addressing mode</b>	<p>Select the addressing mode for the interface.</p> <ul style="list-style-type: none"> <li>• Select <b>Manual</b> and add an <b>IP/Netmask</b> for the interface. If IPv6 configuration is enabled you can add both a IPv4 and an IPv6 IP address.</li> <li>• Select <b>DHCP</b> to get the interface IP address and other network settings from a DHCP server.</li> <li>• Select <b>PPPoE</b> to get the interface IP address and other network settings from a PPPoE server.</li> <li>• Select <b>One-Arm Sniffer</b> to enable the interface as a means to detect possible traffic threats. This option is available on physical ports not configured for the primary Internet connection.</li> <li>• Select <b>Dedicate to FortiAP/FortiSwitch</b> to have a FortiAP unit or FortiSwitch unit connect exclusively to the interface. This option is only available when editing a physical interface, and it has a static IP address. When you enter the IP address, the FortiGate unit automatically creates a DHCP server using the subnet entered. This option is not available on the ADSL interface.</li> </ul> <p>The FortiSwitch option is currently only available on the FortiGate-100D.</p>
<b>IP/Netmask</b>	<p>If <b>Addressing Mode</b> is set to <b>Manual</b>, enter an IPv4 address/subnet mask for the interface. FortiGate interfaces cannot have IP addresses on the same subnet.</p>
<b>IPv6 Address</b>	<p>If <b>Addressing Mode</b> is set to <b>Manual</b> and IPv6 support is enabled, enter an IPv6 address/subnet mask for the interface. A single interface can have both an IPv4 and IPv6 address or just one or the other.</p>
<b>Administrative Access</b>	<p>Select the types of administrative access permitted for IPv4 connections to this interface.</p>

<b>HTTPS</b>	Allow secure HTTPS connections to the web-based manager through this interface. If configured, this option will enable automatically when selecting the <b>HTTP</b> option.
<b>PING</b>	Interface responds to pings. Use this setting to verify your installation and for testing.
<b>HTTP</b>	Allow HTTP connections to the web-based manager through this interface. If configured, this option will also enable the <b>HTTPS</b> option.
<b>SSH</b>	Allow SSH connections to the CLI through this interface.
<b>SNMP</b>	Allow a remote SNMP manager to request SNMP information by connecting to this interface.
<b>TELNET</b>	Allow Telnet connections to the CLI through this interface. Telnet connections are not secure and can be intercepted by a third party.
<b>FMG-Access</b>	Allow FortiManager authorization automatically during the communication exchange between the FortiManager and FortiGate units.
<b>FCT-Access</b>	You can configure a FortiGate interface as an interface that will accept FortiClient connections. When configured, the FortiGate unit sends broadcast messages which the FortiClient software running on a end user PC is listening for.
<b>CAPWAP</b>	Allows the FortiGate unit's wireless controller to manage a wireless access point, such as a FortiAP unit.
<b>IPv6 Administrative Access</b>	Select the types of administrative access permitted for IPv6 connections to this interface. These types are the same as for Administrative Access.
<b>Security Mode</b>	Select a captive portal for the interface. When selected, you can define the portal message and look that the user sees when logging into the interface. You can also define one or more user groups that have access to the interface.
<b>DHCP Server</b>	Select to enable a DHCP server for the interface. For more information on configuring a DHCP server on the interface, see DHCP servers and relays.
<b>Detect and Identify Devices</b>	Select to enable the interface to be used with BYOD hardware such as iPhones. Define the device definitions by going to <b>User &amp; Device &gt; Device</b> .

<b>Add New Devices to Vulnerability Scan List</b>	This option appears when <b>Detect and Identify Devices</b> is enabled. When enabled, the FortiGate unit performs a network vulnerability scan of any devices detected or seen on the interface. The vulnerability scan occurs as configured, either on demand, or as scheduled.
<b>Broadcast Discovery Messages</b>	<p>Available when <b>FCT-Access</b> is enabled for the <b>Administrative Access</b>. Select to enable sends broadcast messages which the FortiClient software running on a end user PC is listening for.</p> <p>Once enabled, the FortiGate unit broadcasts a discovery message that includes the IP address of the interface and listening port number to the local network. All PCs running FortiClient on that network listen for this discovery message.</p>
<b>Enable Explicit Web Proxy</b>	<p>Available when enabling explicit proxy on the <b>System Information Dashboard (System &gt; Dashboard &gt; Status)</b>.</p> <p>This option is not available for a VLAN interface selection. Select to enable explicit web proxying on this interface. When enabled, this interface will be displayed on <b>System &gt; Network &gt; Explicit Proxy</b> under <b>Listen on Interfaces</b> and web traffic on this interface will be proxied according to the Web Proxy settings.</p>
<b>Enable STP</b>	With FortiGate units with a switch interface is in switch mode, this option is enabled by default. It enables the single instance MSTP spanning tree protocol.
<b>Listen for RADIUS Accounting Messages</b>	Select to use the interface as a listening port for RADIUS content.
<b>Secondary IP Address</b>	Add additional IPv4 addresses to this interface. Select the Expand Arrow to expand or hide the section.
<b>Comments</b>	Enter a description up to 255 characters to describe the interface.
<b>Administrative Status</b>	<p>Select either <b>Up</b> (green arrow) or <b>Down</b> (red arrow) as the status of this interface.</p> <p><b>Up</b> indicates the interface is active and can accept network traffic.  <b>Down</b> indicates the interface is not active and cannot accept traffic.</p>
<b>Gi Gatekeeper (FortiOS Carrier only)</b>	For FortiOS Carrier, enable Gi Gatekeeper to enable the Gi firewall as part of the anti-overbilling configuration. You must also configure <b>Gi Gatekeeper Settings</b> by going to <b>System &gt; Admin &gt; Settings</b> .

## Software switch

A software switch, or soft switch, is a virtual switch that is implemented at the software, or firmware level, rather than the hardware level. A software switch can be used to simplify communication between devices connected to different FortiGate interfaces. For example, using a software switch, you can place the FortiGate interface connected to an internal network on the same subnet as your wireless interfaces. Then devices on the internal network can communicate with devices on the wireless network without any additional configuration such as additional security policies, on the FortiGate unit.

It can also be useful if you require more hardware ports on for the switch on a FortiGate unit. For example, if your FortiGate unit has a 4-port switch, WAN1, WAN2 and DMZ interfaces, and you need one more port, you can create a soft switch that can include the 4-port switch and the DMZ interface all on the same subnet. These types of applications also apply to wireless interfaces and virtual wireless interfaces and physical interfaces such as those with FortiWiFi and FortiAP unit.

Similar to a hardware switch, a software switch functions like a single interface. A software switch has one IP address; all of the interfaces in the software switch are on the same subnet. Traffic between devices connected to each interface are not regulated by security policies, and traffic passing in and out of the switch are affected by the same policy.

There are a few things to consider when setting up a software switch:

- Ensure you create a back up of the configuration.
- Ensure you have at least one port or connection such as the console port to connect to the FortiGate unit. If you accidentally combine too many ports, you will need a way to undo any errors.
- The ports that you include must not have any link or relation to any other aspect of the FortiGate unit. For example, DHCP servers, security policies, and so on.
- For increased security, you can create a captive portal for the switch, allowing only specific user groups access to the resources connected to the switch.

### To create a software switch - web-based manager

1. Go to **System > Network > Interface** and select **Create New**.
2. For **Type**, select **Software Switch**.
3. In the **Physical Interface Members** option, select the interfaces to include.
4. Configure the remaining interface settings
5. Select **OK**.

### To create a software switch - CLI

```
config system switch-interface
    edit <switch-name>
        set type switch
        set member <interface_list>
    end
config system interface
    edit <switch_name>
        set ip <ip_address>
        set allowaccess https ssh ping
    end
```

## Soft switch example

For this example, the wireless interface (WiFi) needs to be on the same subnet as the DMZ1 interface to facilitate wireless syncing from an iPhone and a local computer. The syncing between two subnets is problematic. By putting both interfaces on the same subnet the syncing will work. The software switch will accomplish this.



In this example, the soft switch includes a wireless interface. Remember to configure any wireless security before proceeding. If you leave this interface open without any password or other security, it leaves open access to not only the wireless interface but to any other interfaces and devices connected within the software switch.

## Clear the interfaces and back up the configuration

First, ensure that the interfaces are not being used with any other security policy or other use on the FortiGate unit. Check the WiFi and DMZ1 ports to ensure DHCP is not enabled on the interface and there are no other dependencies with these interfaces.

Next, save the current configuration, in the event something doesn't work, recovery can be quick.

## Merge the interfaces

The plan is to merge the WiFi port and DMZ1 port. This will create a software switch with a name of "synchro" with an IP address of 10.10.21.12. The steps will create the switch, add the IP and then set the administrative access for HTTPS, SSH and Ping.

### To merge the interfaces - CLI

```
config system switch-interface
  edit synchro
    set type switch
    set member dmz1 wifi
  end
config system interface
  edit synchro
    set ip 10.10.21.12
    set allowaccess https ssh ping
  end
```

## Final steps

With the switch set up, you can now add security policies, DHCP servers and any other configuration that you would normally do to configure interfaces on the FortiGate unit.

## Virtual Switch

Virtual switch feature enables you create virtual switches on top of the physical switch(es) with designated interfaces/ports so that a virtual switch can build up its forwarding table through learning and forward traffic accordingly. When traffic is forwarded among interfaces belonging to the same virtual switch, the traffic doesn't need to go up to the software stack, but forwarded directly by the switch. When traffic has to be relayed to

interfaces not on the virtual switch, the traffic will go through the normal data path and be offloaded to NP4 when possible.

This feature is only available on mid to high end FortiGate units, including the 100D, 600C, 1000C, and 1240B.

**To enable and configure the virtual switch, enter the CLI commands:**

```
config system virtual-switch
  edit vs1
    set physical-switch sw0
    config port
      edit 1
        set port port1
        set speed xx
        set duplex xx
        set status [up|down]
      edit 2
        set port port2
        set ...
      end
    end
  end
end
```

## Loopback interfaces

A loopback interface is a logical interface that is always up (no physical link dependency) and the attached subnet is always present in the routing table.

The FortiGate's loopback IP address does not depend on one specific external port, and is therefore possible to access it through several physical or VLAN interfaces. Multiple loopback interfaces can be configured in either non-VDOM mode or in each VDOM.

Loopback interfaces still require appropriate firewall policies to allow traffic to and from this type of interface.

A loopback interface can be used with:

- Management access
- BGP (TCP) peering
- PIM RP

Loopback interfaces are a good practice for OSPF. Setting the OSPF router ID the same as loopback IP address troubleshooting OSPF easier, and remembering the management IP addresses (telnet to "router ID").

Dynamic routing protocols can be enabled on loopback interfaces

For black hole static route, use the black hole route type instead of the loopback interface.

## Redundant interfaces

On some models you can combine two or more physical interfaces to provide link redundancy. This feature enables you to connect to two or more switches to ensure connectivity in the event one physical interface or the equipment on that interface fails.

In a redundant interface, traffic is only going over one interface at any time. This differs from an aggregated interface where traffic is going over all interfaces for distribution of increased bandwidth. This difference means redundant interfaces can have more robust configurations with fewer possible points of failure. This is important in a fully-meshed HA configuration.

An interface is available to be in a redundant interface if:

- it is a physical interface, not a VLAN interface
- it is not already part of an aggregated or redundant interface
- it is in the same VDOM as the redundant interface
- it has no defined IP address
- is not configured for DHCP or PPPoE
- it has no DHCP server or relay configured on it
- it does not have any VLAN subinterfaces
- it is not referenced in any security policy, VIP, or multicast policy
- it is not monitored by HA
- it is not one of the FortiGate-5000 series backplane interfaces

When an interface is included in a redundant interface, it is not listed on the **System > Network > Interface** page. You cannot configure the interface individually and it is not available for inclusion in security policies, VIPs, or routing.

## One-armed sniffer

A one-armed sniffer is used to configure a physical interface on the FortiGate unit as a one-arm intrusion detection system (IDS). Traffic sent to the interface is examined for matches to the configured IPS sensor and application control list. Matches are logged and then all received traffic is dropped. Sniffing only reports on attacks. It does not deny or otherwise influence traffic.

Using the one-arm sniffer, you can configure a FortiGate unit to operate as an IDS appliance by sniffing network traffic for attacks without actually processing the packets. To configure one-arm IDS, you enable sniffer mode on a FortiGate interface and connect the interface to a hub or to the SPAN port of a switch that is processing network traffic.

To assign an interface as a sniffer interface, go to **System > Network > Interface**, edit the interface and select **One-Arm Sniffer**.

If the check box is not available, the interface is in use. Ensure that the interface is not selected in any firewall policies, routes, virtual IPs or other features in which a physical interface is specified.

<b>Enable Filters</b>	<p>Select to include filters to define a more granular sniff of network traffic. Select specific addresses, ports, VLANs and protocols.</p> <p>In all cases, enter a number, or number range, for the filtering type. For Protocol values, standard protocols are:</p> <ul style="list-style-type: none"> <li>• UDP - 17</li> <li>• TCP - 6</li> <li>• ICMP - 1</li> </ul>
<b>Include IPv6 Packets</b>	If your network is running a combination of IPv4 and IPv6 addressing, select to sniff both addressing types. Otherwise, the FortiGate unit will only sniff IPv4 traffic.
<b>Include Non-IP Packets</b>	Select for a more intense scan of content in the traffic.
<b>UTM Security Profiles</b>	IPS sensors, and application control lists enable you to select specific sensors and application you want to identify within the traffic.

## Aggregate Interfaces

Link aggregation (IEEE 802.3ad) enables you to bind two or more physical interfaces together to form an aggregated (combined) link. This new link has the bandwidth of all the links combined. If a link in the group fails, traffic is transferred automatically to the remaining interfaces with the only noticeable effect being a reduced bandwidth.

This is similar to redundant interfaces with the major difference being that a redundant interface group only uses one link at a time, where an aggregate link group uses the total bandwidth of the functioning links in the group, up to eight.

Support of the IEEE standard 802.3ad for link aggregation is available on some models.

An interface is available to be an aggregate interface if:

- it is a physical interface, not a VLAN interface or subinterface
- it is not already part of an aggregate or redundant interface
- it is in the same VDOM as the aggregated interface. Aggregate ports cannot span multiple VDOMs.
- it does not have an IP address and is not configured for DHCP or PPPoE
- it is not referenced in any security policy, VIP, IP Pool or multicast policy
- it is not an HA heartbeat interface
- it is not one of the FortiGate-5000 series backplane interfaces

Some models of FortiGate units do not support aggregate interfaces. In this case, the aggregate option is not an option in the web-based manager or CLI. As well, you cannot create aggregate interfaces from the interfaces in a switch port.

To see if a port is being used or has other dependencies, use the following diagnose command:

```
diagnose sys checkused system.interface.name <interface_name>
```



When an interface is included in an aggregate interface, it is not listed on the **System > Network > Interface** page. Interfaces will still appear in the CLI, although configuration for those interfaces will not take effect. You cannot configure the interface individually and it is not available for inclusion in security policies, VIPs, IP pools, or routing.

### Example

This example creates an aggregate interface on a FortiGate-3810A using ports 4-6 with an internal IP address of 10.13.101.100, as well as the administrative access to HTTPS and SSH.

#### To create an aggregate interface - web-based manager

1. Go to **System > Network > Interface** and select **Create New**.
2. Enter the Name as `Aggregate`.
3. For the **Type**, select **802.3ad Aggregate**.  
If this option does not appear, your FortiGate unit does not support aggregate interfaces.
4. In the **Available Interfaces** list, select port 4, 5 and 6 and move it to the **Selected Interfaces** list.
5. Select the **Addressing Mode** of **Manual**.
6. Enter the IP address for the port of 10.13.101.100/24.
7. For **Administrative Access** select HTTPS and SSH.
8. Select **OK**.

#### To create aggregate interface - CLI

```
config system interface
edit Aggregate
set type aggregate
set member port4 port5 port6
set vdom root
set ip 172.20.120.100/24
set allowaccess https ssh
end
```

## DHCP addressing mode on an interface

If you configure an interface to use DHCP, the FortiGate unit automatically broadcasts a DHCP request from the interface. The interface is configured with the IP address and any DNS server addresses and default gateway address that the DHCP server provides.



DHCP IPv6 is similar to DHCP IPv4, however there is:

- no default gateway option defined because a host learns the gateway using router advertisement messages
- there is no WINS servers because it is obsolete.

For more information about DHCP IPv6, see RFC 3315.

Configure DHCP for an interface in **System > Network > Interface** and selecting the interface from the list, and selecting **DHCP** in the **Address Mode**. The table describes the DHCP status information when DHCP is configured for an interface.

Addressing mode section of New Interface page for DHCP informatio	
<b>Status</b>	<p>Displays DHCP status messages as the interface connects to the DHCP server and gets addressing information. Select <b>Status</b> to refresh the addressing mode status message.</p> <p>Status can be one of:</p> <ul style="list-style-type: none"> <li>• <b>initializing</b> - No activity.</li> <li>• <b>connecting</b> - interface attempts to connect to the DHCP server.</li> <li>• <b>connected</b> - interface retrieves an IP address, netmask, and other settings from the DHCP server.</li> <li>• <b>failed</b> - interface was unable to retrieve an IP address and other settings from the DHCP server.</li> </ul>
<b>Obtained IP/Netmask</b>	The IP address and netmask leased from the DHCP server. Only displayed if <b>Status</b> is <b>connected</b> .
<b>Renew</b>	Select to renew the DHCP license for this interface. Only displayed if <b>Status</b> is <b>connected</b> .
<b>Expiry Date</b>	The time and date when the leased IP address and netmask is no longer valid for the interface. The IP address is returned to the pool to be allocated to the next user request for an IP address. Only displayed if <b>Status</b> is <b>connected</b> .
<b>Default Gateway</b>	The IP address of the gateway defined by the DHCP server. Only displayed if <b>Status</b> is <b>connected</b> , and if <b>Receive default gateway from server</b> is selected.
<b>Distance</b>	Enter the administrative distance for the default gateway retrieved from the DHCP server. The administrative distance, an integer from 1-255, specifies the relative priority of a route when there are multiple routes to the same destination. A lower administrative distance indicates a more preferred route.
<b>Retrieve default gateway from server</b>	Enable to retrieve a default gateway IP address from the DHCP server. The default gateway is added to the static routing table.
<b>Override internal DNS</b>	<p>Enable to use the DNS addresses retrieved from the DHCP server instead of the DNS server IP addresses on the DNS page.</p> <p>When VDOMs are enabled, you can override the internal DNS only on the management VDOM.</p>

## PPPoE addressing mode on an interface

If you configure the interface to use PPPoE, the FortiGate unit automatically broadcasts a PPPoE request from the interface.

The FortiGate units support many PPPoE RFC features (RFC 2516) including unnumbered IPs, initial discovery timeout and PPPoE Active Discovery Terminate (PADT).

PPPoE is only configurable in the web-based manager on desktop FortiGate units. 1U FortiGates and up must be configured in the CLI using the commands:

```
config system interface
  edit <port_name>
    set mode pppoe
    set username <ISP_username>
    set password <ISP_password>
    set idle-timeout <seconds>
    set distance <integer>
    set ipunnumbered <unnumbered-IP>
    set disc-retry-timeout <seconds>
    set padt-retry-timeout <seconds>
    set lcp-echo-interval <seconds>
    set dns-server-override {enable | disable}
  end
```

Configure PPPoE on an interface in **System > Network > Interface**. The table describes the PPPoE status information when PPPoE is configured for an interface.

Addressing mode section of New Interface page	
<b>Status</b>	<p>Displays PPPoE status messages as the FortiGate unit connects to the PPPoE server and gets addressing information. Select Status to refresh the addressing mode status message.</p> <p>The status is only displayed if you selected <b>Edit</b>.</p> <p>Status can be any one of the following 4 messages.</p>
<b>Initializing</b>	No activity.
<b>Connecting</b>	The interface is attempting to connect to the PPPoE server.
<b>Connected</b>	<p>The interface retrieves an IP address, netmask, and other settings from the PPPoE server.</p> <p>When the status is connected, PPPoE connection information is displayed.</p>
<b>Failed</b>	The interface was unable to retrieve an IP address and other information from the PPPoE server.

### Addressing mode section of New Interface page

<b>Reconnect</b>	<p>Select to reconnect to the PPPoE server.</p> <p>Only displayed if Status is connected.</p>
<b>User Name</b>	The PPPoE account user name.
<b>Password</b>	The PPPoE account password.
<b>Unnumbered IP</b>	Specify the IP address for the interface. If your ISP has assigned you a block of IP addresses, use one of them. Otherwise, this IP address can be the same as the IP address of another interface or can be any IP address.
<b>Initial Disc Timeout</b>	Enter Initial discovery timeout. Enter the time to wait before starting to retry a PPPoE discovery.
<b>Initial PADT timeout</b>	Enter Initial PPPoE Active Discovery Terminate (PADT) timeout in seconds. Use this timeout to shut down the PPPoE session if it is idle for this number of seconds. PADT must be supported by your ISP. Set initial PADT timeout to 0 to disable.
<b>Distance</b>	Enter the administrative distance for the default gateway retrieved from the PPPoE server. The administrative distance, an integer from 1-255, specifies the relative priority of a route when there are multiple routes to the same destination. A lower administrative distance indicates a more preferred route. The default distance for the default gateway is 1.
<b>Retrieve default gateway from server</b>	Enable to retrieve a default gateway IP address from a PPPoE server. The default gateway is added to the static routing table.
<b>Override internal DNS</b>	<p>Enable to replace the DNS server IP addresses on the System DNS page with the DNS addresses retrieved from the PPPoE server.</p> <p>When VDOMs are enabled, you can override the internal DNS only on the management VDOM.</p>

## Administrative access

Interfaces, especially the public-facing ports can be potentially accessed by those who you may not want access to the FortiGate unit. When setting up the FortiGate unit, you can set the type of protocol an administrator must use to access the FortiGate unit. The options include:

- HTTPS
- HTTP
- SSH
- TELNET
- SNMP

- PING
- FortiManager Access (FMG-Access)
- FortiClient Access (FCT-Access)

You can select as many, or as few, even none, that are accessible by an administrator.

This example adds an IPv4 address 172.20.120.100 to the WAN1 interface as well as the administrative access to HTTPS and SSH. As a good practice, set the administrative access when you are setting the IP address for the port.

#### To add an IP address on the WAN1 interface - web-based manager

1. Go to **System > Network > Interface**.
2. Select the WAN1 interface row and select **Edit**.
3. Select the **Addressing Mode** of **Manual**.
4. Enter the IP address for the port of 172.20.120.100/24.
5. For **Administrative Access**, select **HTTPS** and **SSH**.
6. Select **OK**.

#### To create IP address on the WAN1 interface - CLI

```
config system interface
  edit wan1
    set ip 172.20.120.100/24
    set allowaccess https ssh
  end
```



When adding to, or removing a protocol, you must type the entire list again. For example, if you have an access list of HTTPS and SSH, and you want to add PING, typing:

```
set allowaccess ping
```

...only PING will be set. In this case, you must type...

```
set allowaccess https ssh ping
```

## Wireless

A wireless interface is similar to a physical interface only it does not include a physical connection. The FortiWiFi units enables you to add multiple wireless interfaces that can be available at the same time (the FortiWiFi-30B can only have one wireless interface). On FortiWiFi units, you can configure the device to be either an access point, or a wireless client. As an access point, the FortiWiFi unit can have up to four separate SSIDs, each on their own subnet for wireless access. In client mode, the FortiWiFi only has one SSID, and is used as a receiver, to enable remote users to connect to the existing network using wireless protocols.

Wireless interfaces also require additional security measures to ensure the signal does not get hijacked and data tampered or stolen.

For more information on configuring wireless interfaces see the Deploying Wireless Networks Guide.

## Interface MTU packet size

You can change the maximum transmission unit (MTU) of the packets that the FortiGate unit transmits to improve network performance. Ideally, the MTU should be the same as the smallest MTU of all the networks between the FortiGate unit and the destination of the packets. If the packets that the FortiGate unit sends are larger than the smallest MTU, they are broken up or fragmented, which slows down transmission. You can easily experiment by lowering the MTU to find an MTU size for optimum network performance.

To change the MTU, select Override default MTU value (1500) and enter the MTU size based on the addressing mode of the interface

- 68 to 1 500 bytes for static mode
- 576 to 1 500 bytes for DHCP mode
- 576 to 1 492 bytes for PPPoE mode
- larger frame sizes if supported by the FortiGate model

Only available on physical interfaces. Virtual interfaces associated with a physical interface inherit the physical interface MTU size.

Interfaces on some models support frames larger than the traditional 1500 bytes. Jumbo frames are supported on FortiGate models that have either a SOC2 or NP4lite, except for the FortiGate-30D, as well as on FortiGate-100D series models (for information about your FortiGate unit's hardware, see the Hardware Acceleration guide). For other models, please contact Fortinet Customer Support for the maximum frame size that is supported.

If you need to enable sending larger frames over a route, you need all Ethernet devices on that route to support that larger frame size, otherwise your larger frames will not be recognized and are dropped.

If you have standard size and larger size frame traffic on the same interface, routing alone cannot route them to different routes based only on frame size. However, you can use VLANs to make sure the larger frame traffic is routed over network devices that support that larger size. VLANs will inherit the MTU size from the parent interface. You will need to configure the VLAN to include both ends of the route as well as all switches and routers along the route.

MTU packet size is changed in the CLI. If you select an MTU size larger than your FortiGate unit supports, an error message will indicate this. In this situation, try a smaller MTU size until the value is supported.



In Transparent mode, if you change the MTU of an interface, you must change the MTU of all interfaces on the FortiGate unit to match the new MTU.

---

To change the MTU size, use the following CLI commands:

```
config system interface
  edit <interface_name>
    set mtu-override enable
    set mtu <byte_size>
  end
```

## Secondary IP addresses to an interface

If an interface is configured with a manual or static IP address, you can also add secondary static IP addresses to the interface. Adding secondary IP addresses effectively adds multiple IP addresses to the interface. Secondary IP addresses cannot be assigned using DHCP or PPPoE.

All of the IP addresses added to an interface are associated with the single MAC address of the physical interface and all secondary IP addresses are in the same VDOM as the interface that are added to. You configure interface status detection for gateway load balancing separately for each secondary IP addresses. As with all other interface IP addresses, secondary IP addresses cannot be on the same subnet as any other primary or secondary IP address assigned to a FortiGate interface unless they are in separate VDOMs.

To configure a secondary IP, go to **System > Network > Interface**, select **Edit** or **Create New** and select the **Secondary IP Address** check box.

## Virtual domains

Virtual domains (VDOMs) are a method of dividing a FortiGate unit into two or more virtual units that function as multiple independent units. A single FortiGate unit is then flexible enough to serve multiple departments of an organization, separate organizations, or to act as the basis for a service provider's managed security service.

VDOMs provide separate security domains that allow separate zones, user authentication, security policies, routing, and VPN configurations. By default, each FortiGate unit has a VDOM named root. This VDOM includes all of the FortiGate physical interfaces, modem, VLAN subinterfaces, zones, security policies, routing settings, and VPN settings.

When a packet enters a VDOM, it is confined to that VDOM. In a VDOM, you can create security policies for connections between Virtual LAN (VLAN) subinterfaces or zones in the VDOM. Packets do not cross the virtual domain border internally. To travel between VDOMs, a packet must pass through a firewall on a physical interface. The packet then arrives at another VDOM on a different interface, but it must pass through another firewall before entering the VDOM. Both VDOMs are on the same FortiGate unit. Inter-VDOMs change this behavior in that they are internal interfaces; however their packets go through all the same security measures as on physical interfaces.

This example shows how to enable VDOMs on the FortiGate unit and the basic and create a VDOM accounting on the DMZ2 port and assign an administrator to maintain the VDOM. First enable Virtual Domains on the FortiGate unit. When you enable VDOMs, the FortiGate unit will log you out.

For desktop and low-end FortiGate units, VDOMs are enabled using the CLI. On larger FortiGate units, you can enable on the web-based manager or the CLI. Once enabled all further configuration can be made in the web-based manager or CLI.

### To enable VDOMs - web-based manager

1. Go to **System > Dashboard > Status**.
2. In the **System Information** widget, select **Enable for Virtual Domain**.

The FortiGate unit logs you out. Once you log back in, you will notice that the menu structure has changed. This reflects the global settings for all Virtual Domains

**To enable VDOMs - CLI**

```
config system global
    set vdom-admin enable
end
```

Next, add the VDOM called accounting.

**To add a VDOM - web-based manager**

1. Go to **System > VDOM > VDOM**, and select **Create New**.
2. Enter the VDOM name `accounting`.
3. Select **OK**.

**To add a VDOM - CLI**

```
config vdom
    edit <new_vdom_name>
end
```

With the Virtual Domain created, you can assign a physical interface to it, and assign it an IP address.

**To assign physical interface to the accounting Virtual Domain - web-based manager**

1. Go to **System > Network > Interface**.
2. Select the DMZ2 port row and select **Edit**.
3. For the **Virtual Domain** drop-down list, select **accounting**.
4. Select the **Addressing Mode** of **Manual**.
5. Enter the IP address for the port of 10.13.101.100/24.
6. Set the **Administrative Access** to **HTTPS** and **SSH**.
7. Select **OK**.

**To assign physical interface to the accounting Virtual Domain - CLI**

```
config global
    config system interface
        edit dmz2
            set vdom accounting
            set ip 10.13.101.100/24
            set allowaccess https ssh
        next
    end
```

## Virtual LANs

The term VLAN subinterface correctly implies the VLAN interface is not a complete interface by itself. You add a VLAN subinterface to the physical interface that receives VLAN-tagged packets. The physical interface can belong to a different VDOM than the VLAN, but it must be connected to a network route that is configured for this



VLAN. Without that route, the VLAN will not be connected to the network, and VLAN traffic will not be able to access this interface. The traffic on the VLAN is separate from any other traffic on the physical interface.

FortiGate unit interfaces cannot have overlapping IP addresses, the IP addresses of all interfaces must be on different subnets. This rule applies to both physical interfaces and to virtual interfaces such as VLAN subinterfaces. Each VLAN subinterface must be configured with its own IP address and netmask. This rule helps prevent a broadcast storm or other similar network problems.

Any FortiGate unit, with or without VDOMs enabled, can have a maximum of 255 interfaces in Transparent operating mode. In NAT/Route operating mode, the number can range from 255 to 8192 interfaces per VDOM, depending on the FortiGate model. These numbers include VLANs, other virtual interfaces, and physical interfaces. To have more than 255 interfaces configured in Transparent operating mode, you need to configure multiple VDOMs with many interfaces on each VDOM.

This example shows how to add a VLAN, `vlan_accounting` on the FortiGate unit internal interface with an IP address of 10.13.101.101.

### To add a VLAN - web-based manager

1. Go to **System > Network > Interface** and select **Create New**.

The **Type** is by default set to VLAN.

2. Enter a name for the **VLAN** to `vlan_accounting`.
3. Select the **Internal** interface.
4. Enter the **VLAN ID**.

The VLAN ID is a number between 1 and 4094 that allow groups of IP addresses with the same VLAN ID to be associated together.

5. Select the **Addressing Mode** of **Manual**.
6. Enter the IP address for the port of 10.13.101.101/24.
7. Set the **Administrative Access** to **HTTPS** and **SSH**.
8. Select **OK**.

### To add a VLAN - CLI

```
config system interface
  edit VLAN_1
    set interface internal
    set type vlan
    set vlanid 100
    set ip 10.13.101.101/24
    set allowaccess https ssh
  next
end
```

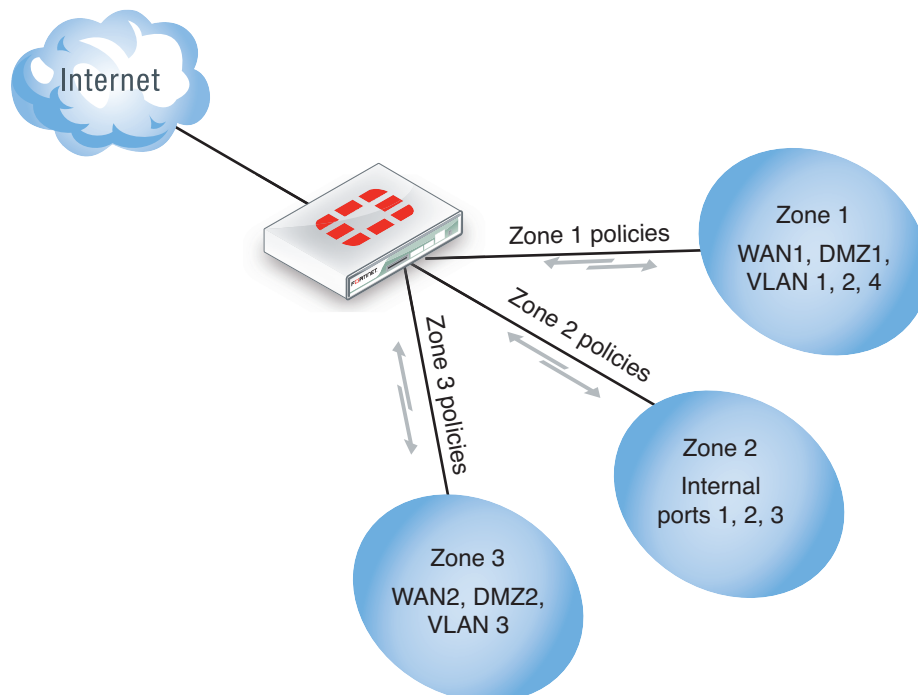
## Zones

Zones are a group of one or more FortiGate interfaces, both physical and virtual, that you can apply security policies to control inbound and outbound traffic. Grouping interfaces and VLAN subinterfaces into zones simplifies the creation of security policies where a number of network segments can use the same policy settings and protection profiles. When you add a zone, you select the names of the interfaces and VLAN subinterfaces to

add to the zone. Each interface still has its own address and routing is still done between interfaces, that is, routing is not affected by zones. Security policies can also be created to control the flow of intra-zone traffic.

For example, in the illustration below, the network includes three separate groups of users representing different entities on the company network. While each group has its own set of port and VLANs, in each area, they can all use the same security policy and protection profiles to access the Internet. Rather than the administrator making nine separate security policies, he can add the required interfaces to a zone, and create three policies, making administration simpler.

### Network zones



You can configure policies for connections to and from a zone, but not between interfaces in a zone. Using the above example, you can create a security policy to go between zone 1 and zone 3, but not between WAN2 and WAN1, or WAN1 and DMZ1.

This example explains how to set up a zone to include the Internal interface and a VLAN.

#### To create a zone - web-based manager

1. Go to **System > Network > Interface**.
2. Select the arrow on the **Create New** button and select **Zone**.
3. Enter a zone name of `Zone_1`.
4. Select the Internal interface and the virtual LAN interface `vlan_accounting` created previously.
5. Select **OK**.

#### To create a zone - CLI

```
config system zone
  edit Zone_1
    set interface internal VLAN_1
  end
```

## Probing interfaces

Server probes can be used on interfaces. In order for this to occur, the probe response mode must first be configured, then the probe response must be allowed administrative access on the interface. The probe response mode can be:

none	Disable probe.
http-probe	HTTP probe.
twamp	Two way active measurement protocol.

Both steps must be done through the CLI.

### Configuring the probe

```
config system probe-response
    set mode http-probe
end
```

### Allowing the probe response to have administrative access to the interface

```
config system interface
    edit <port>
        set allowaccess probe-response
    end
end
```

# Central management

Administering one or two FortiGate units is fairly simple enough, especially when they are in the same room or building. However, if you are administering many FortiGate units that may be located in locations in a large geographical area, or in the world, you will need a more efficient method of maintaining firmware upgrades, configuration changes, and updates.

The FortiManager family of appliances supply the tools needed to effectively manage any size Fortinet security infrastructure, from a few devices to thousands of appliances. FortiManager appliances provide centralized policy-based provisioning, configuration, and update management, as well as end-to-end network monitoring for added control. Managers can control administrative access and simplify policy deployment using role-based administration to define user privileges for specific management domains and functions by aggregating collections of Fortinet appliances and agents into independent management domains. By locally hosting security content updates for managed devices and agents, FortiManager appliances minimize web filtering rating request response time and maximize network protection.

This chapter describes the basics of using FortiManager as an administration tool for multiple FortiGate units. It describes the basics of setting up a FortiGate unit in FortiManager and some key management features you can use within FortiManager to manage the FortiGate unit. For full details and instructions on FortiManager, see the FortiManager Administration Guide.

This section includes the topics:

- [Adding a FortiGate to FortiManager](#)
- [Configuration through FortiManager](#)
- [Firmware updates](#)
- [FortiGuard](#)
- [Backup and restore configurations](#)
- [Administrative domains](#)



In order for the FortiGate unit and FortiManager unit to properly connect, both units must have compatible firmware. To find out if your firmware is compatible, refer to the FortiOS or FortiManager Release Notes.

## Adding a FortiGate to FortiManager

Before you can maintain a FortiGate unit using a FortiManager unit, you need to add it to the FortiManager. This requires configuration on both the FortiGate and FortiManager. This section describes the basics to configure management using a FortiManager device. For more information on the interaction of FortiManager with the FortiGate unit, see the FortiManager documentation.

### FortiGate configuration

These steps ensure that the FortiGate unit will be able to receive updated antivirus and IPS updates and allow remote management through the FortiManager system. You can add a FortiGate unit whether it is running in

either NAT mode or transparent mode. The FortiManager unit provides remote management of a FortiGate unit over TCP port 541.

If you have not already done so, register the FortiGate unit by visiting <http://support.fortinet.com> and select **Product Registration**. By registering your Fortinet unit, you will receive updates to threat detection and prevention databases (Antivirus, Intrusion Detection, etc.) and will also ensure your access to technical support.

You must enable the FortiGate management option so the FortiGate unit can accept management updates to firmware, antivirus signatures, and IPS signatures.

### To configure the FortiGate unit - web-based manager

1. Log in to the FortiGate unit.
2. Go to **System > Admin > Settings**.
3. Enter the **IP address** for the FortiManager unit.
4. Select **Send Request**.

The FortiManager ID now appears in the Trusted FortiManager table.

As an additional security measure, you can also select **Registration Password** and enter a password to connect to the FortiManager.

### To configure the FortiGate unit - CLI

```
config system central-management
  set fmg <ip_address>
end
```

To use the registration password enter:

```
execute central-mgmt register-device <fmg-serial-no><fmg-register-password><fgt-username><fgt-password>
```

## Configuring an SSL connection

An SSL connection can be configured between the two devices and an encryption level selected. Use the following CLI commands in the FortiGate CLI to configure the connection:

```
config system central-management
  set status enable
  set enc-algorithm {default* | high | low}
end
```

The default encryption automatically sets high and medium encryption algorithms. Algorithms used for high, medium, and low follows openssl definitions:

- **High** - Key lengths larger than 128 bits, and some cipher suites with 128-bit keys.

Algorithms are: DHE-RSA-AES256-SHA:AES256-SHA: EDH-RSA-DES-CBC3-SHA: DES-CBC3-SHA:DES-CBC3-MD5:DHE-RSA-AES128-SHA:AES128-SHA

- **Medium** - Key strengths of 128 bit encryption.

Algorithms are: RC4-SHA:RC4-MD5:RC4-MD

- **Low** - Key strengths of 64 or 56 bit encryption algorithms but excluding export cipher suites

Algorithms are: EDH-RSA-DES-CBC-SHA; DES-CBC-SHA; DES-CBC-MD5.

## FortiManager configuration

Once the connection between the FortiGate unit and the FortiManager unit has been configured, you can add the FortiGate to the Device Manager in the FortiManager unit's web-based manager. For details on completing the configuration, see the [FortiManager Administration Guide](#).

## Configuration through FortiManager

With the FortiManager system, you can monitor and configure multiple FortiGate units from one location. Using the FortiManager's Device Manager, you can view the FortiGate units and make the usual configuration updates and changes, without having to log in and out of multiple FortiGate units.

FortiManager enables you to complete the configuration, by going to the Device Manager, selecting the FortiGate unit and using the same menu structure and pages as you would see in the FortiGate web-based manager. All changes to the FortiGate configuration are stored locally on the FortiManager unit until you synchronize with the FortiGate unit.

When a FortiGate unit is under control of a FortiManager system, administrators will not be able to change the configuration using the FortiGate. When trying to change options, the unit displays a message that it is configured through FortiManager, and any changes may be reverted.

## Global objects

If you are maintaining a number of FortiGate units within a network, many of the policies and configuration elements will be the same across the corporation. In these instances, the adding and editing of many of the same policies will become a tedious and error-prone activity. With FortiManager global objects, this level of configuration is simplified.

A global object is an object that is not associated specifically with one device or group. Global objects include security policies, a DNS server, VPN, and IP pools.

The Global Objects window is where you can configure global objects and copy the configurations to the FortiManager device database for a selected device or a group of devices. You can also import configurations from the FortiManager device database for a selected device and modify the configuration as required.

When configuring or creating a global policy object the interface, prompts, and fields are the same as creating the same object on a FortiGate unit using the FortiGate web-based manager.

## Locking the FortiGate web-based manager

When you use the FortiManager to manage multiple FortiGate units, a local FortiGate unit becomes locked from any configuration changes using the web-based manager for most administrators. The `super_admin` will still be able to make changes to the configuration; however, this is not recommended as it may cause conflicts with the FortiManager.

## Firmware updates

A FortiManager unit can also perform firmware updates for multiple FortiGate units, saving time rather than upgrading each FortiGate unit individually.

The FortiManager unit stores local copies of firmware images, either by downloading images from the Fortinet Distribution Network (FDN) or by accepting firmware images that are uploaded from the management computer.

If you are using the FortiManager unit to download firmware images, the FDN first validates device licenses and support contracts and then provides a list of currently available firmware images. For devices with valid Fortinet Technical Support contracts, you can download new firmware images from the FDN and the firmware release notes.

After firmware images have been either downloaded from the FDN or imported to the firmware list, you can either schedule or immediately upgrade/downgrade a device or group of device's firmware.

See the [FortiManager Administration Guide](#) for more information on updating the FortiGate firmware using the FortiManager central management.

## FortiGuard

FortiManager can also connect to the FortiGuard Distribution Network (FDN) to receive push updates for IPS signatures and antivirus definitions. These updates can then be used to update multiple FortiGate units throughout an organization. By using the FortiManager as the host for updates, bandwidth use is minimized as updates are downloaded to one source instead of many.

To receive IPS and antivirus updates from FortiManager, indicate an alternate IP address on the FortiGate unit.

### To configure updates from FortiManager

1. Go to **System > Config > FortiGuard**.
2. Select **AntiVirus and IPS Options** to expand the options.
3. Enable both **Allow Push Update** and **Use override push IP**.
4. Enter the IP address of the FortiManager unit.
5. Select **Apply**.

## Backup and restore configurations

A FortiManager unit stores configuration files for backup and restore purposes. A FortiManager also enables you to save revisions of configuration files. Configuration backups occur automatically when the administrator logs out or the administrator login session expires.

FortiManager also enables you to view differences between different configurations to view where changes have been made.

## Administrative domains

FortiManager administrative domains enable the super\_admin to create groupings of devices for configured administrators to monitor and manage. FortiManager can manage a large number of Fortinet appliances. This enables administrators to maintain managed devices specific to their geographic location or business division. This also includes FortiGate units with multiple configured VDOMs.

Each administrator is tied to an administrative domain (ADOM). When that particular administrator logs in, they see only those devices or VDOMs configured for that administrator and ADOM. The one exception is the super\_admin account that can see and maintain all administrative domains and the devices within those domains.

Administrative domains are not enabled by default and enabling and configuring the domains can only be performed by the super\_admin.

The maximum number of administrative domains you can add depends on the FortiManager system model. See the FortiManager Administration Guide for information on the maximums for each model.



# Monitoring

With network administration, the first step is installing and configuring the FortiGate unit to be the protector of the internal network. Once the system is running efficiently, the next step is to monitor the system and network traffic, making configuration changes as necessary when a threat or vulnerability is discovered.

This chapter discusses the various methods of monitoring both the FortiGate unit and the network traffic through a range of different tools available within FortiOS.

This section includes the topics:

- [Dashboard](#)
- [sFlow](#)
- [Monitor menus](#)
- [Logging](#)
- [Alert email](#)
- [SNMP](#)
- [SNMP get command syntax](#)

## Dashboard

The FortiOS dashboard provides a location to view real-time system information. By default, the dashboard displays the key statistics of the FortiGate unit itself, providing the memory and CPU status, as well as the health of the ports, whether they are up or down and their throughput.

## Widgets

Within the dashboard is a number of smaller windows, called widgets, that provide this status information. Beyond what is visible by default, you can add a number of other widgets that display other key traffic information including application use, traffic per IP address, top attacks, traffic history and logging statistics.

You can add multiple dashboards to reflect what data you want to monitor, and add the widgets accordingly. Dashboard configuration is only available through the web-based manager. Administrators must have read and write privileges to customize and add widgets when in either menu. Administrators must have read privileges if they want to view the information.

### To add a dashboard and widgets

1. Go to **System > Dashboard > Status**.
2. Select the **Dashboard** menu at the top of the window and select **Add Dashboard**.
3. Enter a name.
4. Select the **Widget** menu at the top of the window.
5. From the screen, select the type of information you want to add.
6. When done, select the X in the top right of the widget.

Dashboard widgets provide an excellent method to view real-time data about the events occurring on the FortiGate unit and the network. For example, by adding the Network Protocol Usage widget, you can monitor the activity of various protocols over a selected span of time. Based on that information you can add or adjust traffic shaping and/or security policies to control traffic.

## FortiClient software

The **License Information** widget includes information for the FortiClient connections. It displays the number of FortiClient connections allowed and the number of users connecting. By selecting the **Details** link for the number of connections, you can view more information about the connecting user, including IP address, user name, and type of operating system the user is connecting with.

Included with this information is a link for Mac and Windows. Selecting these links automatically downloads the FortiClient install file (.dmg or .exe) to the management computer.

## sFlow

sFlow is a method of monitoring the traffic on your network to identify areas on the network that may impact performance and throughput. FortiOS implements sFlow version 5.

sFlow uses packet sampling to monitor network traffic. The sFlow Agent captures packet information at defined intervals and sends them to an sFlow Collector for analysis, providing real-time data analysis. The information sent is only a sampling of the data for minimal impact on network throughput and performance.

The sFlow Agent is embedded in the FortiGate unit. Once configured, the FortiGate unit sends sFlow datagrams of the sampled traffic to the sFlow Collector, also called an sFlow Analyzer. The sFlow Collector receives the datagrams, and provides real-time analysis and graphing to indicate where potential traffic issues are occurring. sFlow Collector software is available from a number of third party software vendors.

sFlow data captures only a sampling of network traffic, not all traffic like the traffic logs on the FortiGate unit. Sampling works by the sFlow Agent looking at traffic packets when they arrive on an interface. A decision is made whether the packet is dropped and allowed to be to its destination or if a copy is forwarded to the sFlow Collector. The sample used and its frequency are determined during configuration.

sFlow is not supported on virtual interfaces such as vdom link, ipsec, ssl.root or gre.

The sFlow datagram sent to the Collector contains the information:

- Packet header (e.g. MAC,IPv4,IPv6,IPX,AppleTalk,TCP,UDP, ICMP)
- Sample process parameters (rate, pool etc.)
- Input/output ports
- Priority (802.1p and TOS)
- VLAN (802.1Q)
- Source/destination prefix
- Next hop address
- Source AS, Source Peer AS
- Destination AS Path
- Communities, local preference
- User IDs (TACACS/RADIUS) for source/destination

- URL associated with source/destination
- Interface statistics (RFC 1573, RFC 2233, and RFC 2358)

sFlow agents can be added to any type of FortiGate interface. sFlow isn't supported on some virtual interfaces such as VDOM link, IPsec, gre, and ssl.root.

For more information on sFlow, Collector software and sFlow MIBs, visit [www.sflow.org](http://www.sflow.org).

## Configuration

sFlow configuration is available only from the CLI. Configuration requires two steps: enabling the sFlow Agent and configuring the interface for the sampling information.

### Enable sFlow

```
config system sflow
  set collector-ip <ip_address>
  set collector-port <port_number>
  set source-ip <ip_address>
end
```

The default port for sFlow is UDP 6343. To configure in VDOM, use the commands:

```
config system vdom-sflow
  set vdom-sflow enable
  set collector-ip <ip_address>
  set collector-port <port_number>
  set source-ip <ip_address>
end
```

Configure sFlow agents per interface.

```
config system interface
  edit <interface_name>
    set sflow-sampler enable
    set sample-rate <every_n_packets>
    set sample-direction [tx | rx | both]
    set polling-interval <seconds>
  end
```

## Monitor menus

The **Monitor** menus enable you to view session and policy information and other activity occurring on your FortiGate unit. The monitors provide the details of user activity, traffic and policy usage to show live activity. Monitors are available for DHCP, routing, security policies, traffic shaping, load balancing, security features, VPN, users, WiFi, and logging.

## Logging

FortiOS provides a robust logging environment that enables you to monitor, store, and report traffic information and FortiGate events, including attempted log ins and hardware status. Depending on your requirements, you

can log to a number of different hosts.

To configure logging in the web-based manager, go to **Log & Report > Log Config > Log Settings**.

To configure logging in the CLI use the commands `config log <log_location>`.

For details on configuring logging see the Logging and Reporting Guide.

If you will be using several FortiGate units, you can also use a FortiAnalyzer unit for logging. For more information, see the FortiAnalyzer Administration Guide.

## FortiCloud

The FortiCloud is a subscription-based hosted service. With this service, you can have centralized management, logging, and reporting capabilities available in FortiAnalyzer and FortiManager platforms, without any additional hardware to purchase, install or maintain. In most cases, FortiCloud is the recommended location for saving and viewing logs.

This service includes a full range of reporting, analysis and logging, firmware management and configuration revision history. It is hosted within the Fortinet global FortiGuard Network for maximum reliability and performance, and includes reporting, and drill-down analysis widgets makes it easy to develop custom views of network and security events.

The FortiGate unit sends log messages to the FortiCloud using TCP port 443. Configuration is available once a user account has been set up and confirmed. To enable the account on the FortiGate unit, go to **System > Dashboard > Status**, in the **Licence Information** widget select **Activate**, and enter the account ID.

For FortiCloud traffic, you can identify a specific port/IP address for logging traffic. Configuration of these services is performed in the CLI, using the command `set source-ip`. When configured, this becomes the dedicated port to send this traffic over.

For example, to set the source IP of the FortiCloud server to be on the DMZ1 port with an IP of 192.168.4.5, the commands are:

```
config log fortiguard setting
  set status enable
  set source-ip 192.168.4.5
end
```

From the FortiGate unit, you can configure the connection and sending of log messages to be sent over an SSL tunnel to ensure log messages are sent securely. To do this, use the CLI commands to enable the encrypted connection and define the level of encryption.

```
config log fortiguard setting
  set status enable
  set enc-algorithm {default | high | low | disable}
end
```

## FortiGate memory

Logs are saved to the internal memory by default. Inexpensive yet volatile, for basic event logs or verifying traffic, AV or spam patterns, logging to memory is a simple option. However, because logs are stored in the limited space of the internal memory, only a small amount is available for logs. As such logs can fill up and be overridden with new entries, negating the use of recursive data. This is especially true for traffic logs. Also, should the FortiGate unit be shut down or rebooted, all log information will be lost.

## FortiGate hard disk

For those FortiGate units with an internal hard disk or SDHC card, you can store logs to this location. Efficient and local, the hard disk provides a convenient storage location. If you choose to store logs in this manner, remember to backup the log data regularly.

Configure log disk settings is performed in the CLI using the commands:

```
config log disk setting
    set status enable
end
```

Further options are available when enabled to configure log file sizes, and uploading/backup events.

As well, note that the write speeds of hard disks compared to the logging of ongoing traffic may cause the dropping such, it is recommended that traffic logging be sent to a FortiAnalyzer or other device meant to handle large volumes of data.

## Syslog server

An industry standard for collecting log messages, for off-site storage. In the web-based manager, you are able to send logs to a single syslog server, however in the CLI you can configure up to three syslog servers where you can also use multiple configuration options. For example, send traffic logs to one server, antivirus logs to another. The FortiGate unit sends Syslog traffic over UDP port 514. Note that if a secure tunnel is configured for communication to a FortiAnalyzer unit, then Syslog traffic will be sent over an IPsec connection, using UDP 500/4500, Protocol IP/50.

To configure a Syslog server in the web-based manager, go to **Log & Report > Log Config > Log Settings**. In the CLI use the commands:

```
config log syslogd setting
    set status enable
    set server <IP address or FQDN of syslog server>
end
```

Further options are available when enabled to configure a different port, facility and server IP address.

For Syslog traffic, you can identify a specific port/IP address for logging traffic. Configuration of these services is performed in the CLI, using the command `set source-ip`. When configured, this becomes the dedicated port to send this traffic over.

For example, to set the source IP of a Syslog server to be on the DMZ1 port with an IP of 192.168.4.5, the commands are:

```
config log syslogd setting
    set status enable
    set source-ip 192.168.4.5
end
```

## FortiAnalyzer

The FortiAnalyzer family of logging, analyzing, and reporting appliances securely aggregate log data from Fortinet devices and other syslog-compatible devices. Using a comprehensive suite of easily-customized reports, users can filter and review records, including traffic, event, virus, attack, Web content, and email data, mining the

data to determine your security stance and assure regulatory compliance. FortiAnalyzer also provides advanced security management functions such as quarantined file archiving, event correlation, vulnerability assessments, traffic analysis, and archiving of email, Web access, instant messaging and file transfer content.

The FortiGate unit sends log messages over UDP port 514 or OFTP (TCP 514). If a secure connection has been configured, log traffic is sent over UDP port 500/4500, Protocol IP/50.

For FortiAnalyzer traffic, you can identify a specific port/IP address for logging traffic. Configuration of these services is performed in the CLI, using the command `set source-ip`. When configured, this becomes the dedicated port to send this traffic over.

For example, to set the source IP of a FortiAnalyzer unit to be on port 3 with an IP of 192.168.21.12, the commands are:

```
config log fortiguard setting
  set status enable
  set source-ip 192.168.21.12
end
```

## Sending logs using a secure connection

From the FortiGate unit, you can configure the connection and sending of log messages over an SSL tunnel to ensure log messages are sent securely. To do this, use the CLI commands below to enable the encrypted connection and define the level of encryption.



You must configure the secure tunnel on **both** ends of the tunnel, the FortiGate unit and the FortiAnalyzer unit.

### To configure a secure connection to the FortiAnalyzer unit

On the FortiAnalyzer unit, enter the commands:

```
config log device
  edit <device_name>
    set secure psk
    set psk <name_of_IPsec_tunnel>
    set id <fortigate_device_name_on_the_fortianalyzer>
  end
```

### To configure a secure connection on the FortiGate unit

On the FortiGate CLI, enter the commands:

```
config log fortianalyzer setting
  set status enable
  set server <ip_address>
  set localid <name_of_IPsec_tunnel>
end
```

## Configuring an SSL connection

An SSL connection can be configured between the two devices, and an encryption level selected.

Use the CLI commands to configure the encryption connection:

```
config log fortianalyzer setting
    set status enable
    set enc-algorithm {default* | high | low | disable}
end
```

The default encryption automatically sets high and medium encryption algorithms. Algorithms used for high, medium, and low follows openssl definitions:

- **High** - Key lengths larger than 128 bits, and some cipher suites with 128-bit keys.

Algorithms are: DHE-RSA-AES256-SHA:AES256-SHA: EDH-RSA-DES-CBC3-SHA: DES-CBC3-SHA:DES-CBC3-MD5:DHE-RSA-AES128-SHA:AES128-SHA

- **Medium** - Key strengths of 128 bit encryption.

Algorithms are: RC4-SHA:RC4-MD5:RC4-MD

- **Low** - Key strengths of 64 or 56 bit encryption algorithms but excluding export cipher suites

Algorithms are: EDH-RSA-DES-CBC-SHA; DES-CBC-SHA; DES-CBC-MD5.

If you want to use an IPsec tunnel to connect to the FortiAnalyzer unit, you need to first disable the enc-algorithm:

```
config log fortianalyzer setting
    set status enable
    set enc-algorithm disable
```

Then set the IPsec encryption:

```
set encrypt enable
set psksecret <preshared_IPsec_tunnel_key>
end
```

## Packet Capture

When troubleshooting networks, it helps to look inside the header of the packets. This helps to determine if the packets, route, and destination are all what you expect. Packet capture can also be called a network tap, packet sniffing, or logic analyzing.

**To use the packet capture.**

1. Go to **System > Network > Packet Capture**.
2. Select **Create New** or an existing entry is there is one that meets your needs.
3. Select the interface to monitor and select the number of packets to keep.
4. Select **Enable Filters**.
5. Enter the information you want to gather from the packet capture.
6. Select **OK**.

To run the capture, select the play button in the progress column in the packet capture list. If not active, **Not Running** will also appear in the column cell. The progress bar will indicate the status of the capture. You can stop and restart it at any time.

When the capture is complete, select the **Download** icon to save the packet capture file to your hard disk for further analysis.

Packet capture tells you what is happening on the network at a low level. This can be very useful for troubleshooting problems, such as:

- finding missing traffic
- seeing if sessions are setting up properly
- locating ARP problems such as broadcast storm sources and causes
- confirming which address a computer is using on the network if they have multiple addresses or are on multiple networks
- confirming routing is working as you expect
- wireless client connection problems
- intermittent missing PING packets
- a particular type of packet is having problems, such as UDP, which is commonly used for streaming video

If you are running a constant traffic application such as ping, packet capture can tell you if the traffic is reaching the destination, how the port enters and exits the FortiGate unit, if the ARP resolution is correct, and if the traffic is returning to the source as expected. You can also use packet switching to verify that NAT or other configuration is translating addresses or routing traffic the way that you want it to.

Before you start capturing packets, you need to have a good idea of what you are looking for. Capture is used to confirm or deny your ideas about what is happening on the network. If you try capture without a plan to narrow your search, you could end up with too much data to effectively analyze. On the other hand, you need to capture enough packets to really understand all of the patterns and behavior that you are looking for.

## Alert email

As an administrator, you want to be certain you can respond quickly to issues occurring on your network or on the FortiGate unit. Alert emails provide an efficient and direct method of notifying an administrator of events. By configuring alert messages, you can define the threshold when a problem becomes critical and needs attention. When this threshold is reached, the FortiGate unit will send an email to one or more individuals, notifying them of the issue.

In the following example, the FortiGate unit is configured to send email to two administrators (admin1 and admin2) when multiple intrusions are detected every two minutes. The FortiGate unit has its own email address on the mail server.

### To configure the email service

1. Go to **System > Config > Advanced**.
2. In the **Email Service**, complete the following and select **Apply**:

<b>SMTP Server</b>	Enter the address or name of the email server. For example, <code>smtp.example.com</code> .
<b>Default Reply To</b>	Enter an email address to associate with the alert email. This field is optional. If you enter an email address here, it overrides the email address entered when configuring alert email in <b>Log &amp; Report &gt; Alert E-mail</b> .
<b>Authentication</b>	Enable authentication if required by the email server.



<b>Security mode</b>	Choose between <i>None</i> , <i>SMTPS</i> or <i>STARTTLS</i>
<b>Port</b>	25

### To configure alert email - web-based manager

1. Go to **Log & Report > Log Config > Alert E-mail**.
2. Enter the information:

<b>Email from</b>	fortigate@example.com
<b>Email to</b>	admin1@example.com
	admin2@example.com

3. For the **Interval Time**, enter 2.
4. Select **Intrusion Detected**.
5. Select **Apply**.

### To configure alert email - CLI

```
config system email-server
    set port 25
    set server smtp.example.com
    set authenticate enable
    set username FortiGate
    set password *****
end
config alertemail setting
    set username fortigate@example.com
    set mailto1 admin1@example.com
    set mailto2 admin2@example.com
    set filter category
    set IPS-logs enable
end
```

## SNMP

Simple Network Management Protocol (SNMP) enables you to monitor hardware on your network. You can configure the hardware, such as the FortiGate SNMP agent, to report system information and send traps (alarms or event messages) to SNMP managers. An SNMP manager, or host, is typically a computer running an application that can read the incoming trap and event messages from the agent and send out SNMP queries to the SNMP agents. A FortiManager unit can act as an SNMP manager to one or more FortiGate units. FortiOS supports SNMP using IPv4 and IPv6 addressing.

By using an SNMP manager, you can access SNMP traps and data from any FortiGate interface or VLAN subinterface configured for SNMP management access. Part of configuring an SNMP manager is to list it as a host in a community on the FortiGate unit it will be monitoring. Otherwise, the SNMP monitor will not receive any traps from that FortiGate unit or be able to query that unit.

The FortiGate SNMP implementation is read-only. SNMP v1, v2c, and v3 compliant SNMP managers have read-only access to FortiGate system information through queries and can receive trap messages from the FortiGate unit.

To monitor FortiGate system information and receive FortiGate traps, you must first compile the Fortinet and FortiGate Management Information Base (MIB) files. A MIB is a text file that describes a list of SNMP data objects that are used by the SNMP manager. These MIBs provide information the SNMP manager needs to interpret the SNMP trap, event, and query messages sent by the FortiGate unit SNMP agent.

FortiGate core MIB files are available for download by going to **System > Config > SNMP** and selecting the download link on the page.

The Fortinet implementation of SNMP includes support for most of RFC 2665 (Ethernet-like MIB) and most of RFC 1213 (MIB II). For more information, see [“Fortinet MIBs”](#). RFC support for SNMP v3 includes Architecture for SNMP Frameworks (RFC 3411), and partial support of User-based Security Model (RFC 3414).

SNMP traps alert you to events that occur such as an a full log disk or a virus detected.

SNMP fields contain information about the FortiGate unit, such as CPU usage percentage or the number of sessions. This information is useful for monitoring the condition of the unit on an ongoing basis and to provide more information when a trap occurs.

The FortiGate SNMP v3 implementation includes support for queries, traps, authentication, and privacy. Authentication and encryption are configured in the CLI. See the `system snmp user` command in the FortiGate CLI Reference.

## SNMP configuration settings

Before a remote SNMP manager can connect to the FortiGate agent, you must configure one or more FortiGate interfaces to accept SNMP connections by going to **System > Network > Interface**. Select the interface and, in the **Administrative Access**, select **SNMP**.

For VDOMS, SNMP traps can only be sent on interfaces in the management VDOM. Traps cannot be sent over other interfaces outside the management VDOM.

To configure SNMP settings, go to **System > Config > SNMP**.

<b>SNMP Agent</b>	Select to enable SNMP communication.
<b>Description</b>	Enter descriptive information about the FortiGate unit. The description can be up to 35 characters.
<b>Location</b>	Enter the physical location of the FortiGate unit. The system location description can be up to 35 characters long.
<b>Contact</b>	Enter the contact information for the person responsible for this FortiGate unit. The contact information can be up to 35 characters.
<b>SNMP v1/v2c section</b> To create a new SNMP community, see <a href="#">SNMP Community</a> page.	
<b>Community Name</b>	The name to identify the community.

<b>Queries</b>	Indicates whether queries protocols (v1 and v2c) are enabled or disabled. A green check mark indicates queries are enabled; a gray x indicates queries are disabled. If one query is disabled and another one enabled, there will still be a green check mark.
<b>Traps</b>	Indicates whether trap protocols (v1 and v2c) are enabled or disabled. A green check mark indicates traps are enabled; a gray x indicates traps are disabled. If one query is disabled and another one enabled, there will still be a green check mark.
<b>Enable</b>	Select the check box to enable or disable the community.
<b>SNMP v3 section</b> To create a new SNMP community, see <a href="#">SNMP Community</a> pager.	
<b>User Name</b>	The name of the SNMPv3 user.
<b>Security Level</b>	The security level of the user.
<b>Notification Host</b>	The IP address or addresses of the host.
<b>Queries</b>	Indicates whether queries are enabled or disabled. A green check mark indicates queries are enabled; a gray x indicates queries are disabled
<b>New SNMP Community page</b>	
<b>Community Name</b>	Enter a name to identify the SNMP community
<b>Hosts (section)</b>	
<b>IP Address</b>	<p>Enter the IP address and Identify the SNMP managers that can use the settings in this SNMP community to monitor the FortiGate unit.</p> <p>You can also set the IP address to 0.0.0.0 to so that any SNMP manager can use this SNMP community.</p>
<b>Interface</b>	<p>Optionally, select the name of the interface that this SNMP manager uses to connect to the FortiGate unit. You only have to select the interface if the SNMP manager is not on the same subnet as the FortiGate unit. This can occur if the SNMP manager is on the Internet or behind a router.</p> <p>In virtual domain mode, the interface must belong to the management VDOM to be able to pass SNMP traps.</p>
<b>Delete</b>	Removes an SNMP manager from the list within the <b>Hosts</b> section.
<b>Add</b>	Select to add a blank line to the Hosts list. You can add up to eight SNMP managers to a single community.
<b>Queries (section)</b>	

<b>Protocol</b>	The SNMP protocol. In the v1 row, this means that the settings are for SNMP v1. In the v2c row, this means that the settings are for SNMP v2c.
<b>Port</b>	<p>Enter the port number (161 by default) that the SNMP managers in this community use for SNMP v1 and SNMP v2c queries to receive configuration information from the FortiGate unit. Select the <b>Enable</b> check box to activate queries for each SNMP version.</p> <p><b>Note:</b> The SNMP client software and the FortiGate unit must use the same port for queries.</p>
<b>Enable</b>	Select to enable that SNMP protocol.
<b>Traps (section)</b>	
<b>Protocol</b>	The SNMP protocol. In the v1 row, this means that the settings are for SNMP v1. In the v2c row, this means that the settings are for SNMP v2c.
<b>Local</b>	<p>Enter the remote port numbers (port 162 for each by default) that the FortiGate unit uses to send SNMP v1 or SNMP v2c traps to the SNMP managers in this community. Select the <b>Enable</b> check box to activate traps for each SNMP version.</p> <p><b>Note:</b> The SNMP client software and the FortiGate unit must use the same port for traps.</p>
<b>Remote</b>	<p>Enter the remote port number (port 162 is default) that the FortiGate unit uses to send SNMP v1 or v2c traps to the SNMP managers in this community.</p> <p><b>Note:</b> The SNMP client software and the FortiGate unit must use the same port for queries.</p>
<b>Enable</b>	Select to activate traps for each SNMP version.
<b>SNMP Event</b>	<p>Enable each SNMP event for which the FortiGate unit should send traps to the SNMP managers in this community.</p> <p><b>CPU Over usage</b> traps sensitivity is slightly reduced, by spreading values out over 8 polling cycles. This prevents sharp spikes due to CPU intensive short-term events such as changing a policy.</p> <p><b>Power Supply Failure</b> event trap is available only on some models.</p> <p><b>AMC interfaces enter bypass mode</b> event trap is available only on models that support AMC modules.</p>
<b>Enable</b>	Select to enable the SNMP event.
<b>Create New SNMP V3 User</b>	

<b>User Name</b>	Enter the name of the user.
<b>Security Level</b>	Select the type of security level the user will have.
<b>Notification Host</b>	Enter the IP address of the notification host. If you want to add more than one host, after entering the IP address of the first host, select the plus sign to add another host.
<b>Enable Query</b>	Select to enable or disable the query. By default, the query is enabled.
<b>Port</b>	Enter the port number in the field.
<b>Events</b>	Select the SNMP events that will be associated with that user.

## Gigabit interfaces

When determining the interface speed of a FortiGate unit with a 10G interface, the IF-MIB.ifSpeed may not return the correct value. IF-MIB.ifSpeed is a 32-bit gauge used to report interface speeds in bits/second and cannot convert to a 64-bit value. The 32-bit counter wrap the output too fast to be accurate.

In this case, you can use the value ifHighSpeed. It reports interface speeds in megabits/second. This ensures that 10Gb interfaces report the correct value.

## SNMP agent

You need to first enter information and enable the FortiGate SNMP Agent. Enter information about the FortiGate unit to identify it so that when your SNMP manager receives traps from the FortiGate unit, you will know which unit sent the information.

### To configure the SNMP agent - web-based manager

1. Go to **System > Config > SNMP**.
2. Select **Enable** for the **SNMP Agent**.
3. Enter a descriptive name for the agent.
4. Enter the location of the FortiGate unit.
5. Enter a contact or administrator for the SNMP Agent or FortiGate unit.
6. Select **Apply**.

### To configure SNMP agent - CLI

```
config system snmp sysinfo
    set status enable
    set contact-info <contact_information>
    set description <description_of_FortiGate>
    set location <FortiGate_location>
end
```

## SNMP community

An SNMP community is a grouping of devices for network administration purposes. Within that SNMP community, devices can communicate by sending and receiving traps and other information. One device can belong to multiple communities, such as one administrator terminal monitoring both a firewall SNMP and a printer SNMP community.

Add SNMP communities to your FortiGate unit so that SNMP managers can connect to view system information and receive SNMP traps.

You can add up to three SNMP communities. Each community can have a different configuration for SNMP queries and traps. Each community can be configured to monitor the FortiGate unit for a different set of events. You can also add the IP addresses of up to 8 SNMP managers to each community.

When the FortiGate unit is in virtual domain mode, SNMP traps can only be sent on interfaces in the management virtual domain. Traps cannot be sent over other interfaces.

### To add an SNMP v1/v2c community - web-based manager

1. Go to **System > Config > SNMP**.
2. In the **SNMP v1/v2c** area, select **Create New**.
3. Enter a **Community Name**.
4. Enter the IP address and Identify the SNMP managers that can use the settings in this SNMP community to monitor the FortiGate unit.
5. Select the interface if the SNMP manager is not on the same subnet as the FortiGate unit.
6. Enter the **Port** number that the SNMP managers in this community use for SNMP v1 and SNMP v2c queries to receive configuration information from the FortiGate unit. Select the **Enable** check box to activate queries for each SNMP version.
7. Enter the Local and Remote port numbers that the FortiGate unit uses to send SNMP v1 and SNMP v2c traps to the SNMP managers in this community.
8. Select the **Enable** check box to activate traps for each SNMP version.
9. Select **OK**.

### To add an SNMP v1/v2c community - CLI

```
config system snmp community
  edit <index_number>
    set events <events_list>
    set name <community_name>
    set query-v1-port <port_number>
    set query-v1-status {enable | disable}
    set query-v2c-port <port_number>
    set query-v2c-status {enable | disable}
    set status {enable | disable}
    set trap-v1-lport <port_number>
    set trap-v1-rport <port_number>
    set trap-v1-status {enable | disable}
    set trap-v2c-lport <port_number>
    set trap-v2c-rport <port_number>
    set trap-v2c-status {enable | disable}
  end
```

**To add an SNMP v3 community - web-based manager**

1. Go to **System > Config > SNMP**.
2. In the **SNMP v3** area, select **Create New**.
3. Enter a **User Name**.
4. Select a **Security Level** and associated authorization algorithms.
5. Enter the IP address of the **Notification Host** SNMP managers that can use the settings in this SNMP community to monitor the FortiGate unit.
6. Enter the **Port** number that the SNMP managers in this community use to receive configuration information from the FortiGate unit. Select the **Enable** check box to activate queries for each SNMP version.
7. Select the **Enable** check box to activate traps.
8. Select **OK**.

**To add an SNMP v3 community - CLI**

```
config system snmp user
  edit <index_number>
    set security-level [auth-priv | auth-no-priv | no-auth-no-priv]
    set queries enable
    set query-port <port_number>
    set notify-hosts <ip_address>
    set events <event_selections>
  end
```

## Enabling on the interface

Before a remote SNMP manager can connect to the FortiGate agent, you must configure one or more FortiGate interfaces to accept SNMP connections.

**To configure SNMP access - web-based manager**

1. Go to **System > Network > Interface**.
2. Choose an interface that an SNMP manager connects to and select **Edit**.
3. In **Administrative Access**, select **SNMP**.
4. Select **OK**.

**To configure SNMP access - CLI**

```
config system interface
  edit <interface_name>
    set allowaccess snmp
  end
```



If the interface you are configuring already has protocols that are allowed access, use the command `append allowaccess snmp` instead, or else the other protocols will be replaced. For more information, see Adding and removing options from lists.

---

## Fortinet MIBs

The FortiGate SNMP agent supports Fortinet proprietary MIBs as well as standard RFC 1213 and RFC 2665 MIBs. RFC support includes support for the parts of RFC 2665 (Ethernet-like MIB) and the parts of RFC 1213 (MIB II) that apply to FortiGate unit configuration.

There are two MIB files for FortiGate units - the Fortinet MIB, and the FortiGate MIB. The Fortinet MIB contains traps, fields and information that is common to all Fortinet products. The FortiGate MIB contains traps, fields and information that is specific to FortiGate units. Each Fortinet product has its own MIB. If you use other Fortinet products you will need to download their MIB files as well. Both MIB files are used for FortiOS and FortiOS Carrier; there are no additional traps for the Carrier version of the operating system.

The Fortinet MIB and FortiGate MIB along with the two RFC MIBs are listed in tables in this section. You can download the two FortiGate MIB files from Fortinet Customer Support. The Fortinet MIB contains information for Fortinet products in general. the Fortinet FortiGate MIB includes the system information for The FortiGate unit and version of FortiOS. Both files are required for proper SNMP data collection.

To download the MIB files, go to **System > Config > SNMP** and select a MIB link in the **FortiGate SNMP MIB** section.

Your SNMP manager may already include standard and private MIBs in a compiled database that is ready to use. You must add the Fortinet proprietary MIB to this database to have access to the Fortinet specific information.



There were major changes to the MIB files between FortiOS Carrier v3.0 and v4.0. You need to use the new MIBs for FortiOS Carrier v4.0 or you may mistakenly access the wrong traps and fields.

MIB files are updated for each version of FortiOS. When upgrading the firmware ensure that you updated the Fortinet FortiGate MIB file as well.

## Fortinet MIBs

MIB file name or RFC	Description
<b>FORTINET-CORE-MIB.mib</b>	<p>The Fortinet MIB includes all system configuration information and trap information that is common to all Fortinet products.</p> <p>Your SNMP manager requires this information to monitor FortiGate unit configuration settings and receive traps from the FortiGate SNMP agent.</p>
<b>FORTINET-FORTIGATE-MIB.mib</b>	<p>The FortiGate MIB includes all system configuration information and trap information that is specific to FortiGate units.</p> <p>Your SNMP manager requires this information to monitor FortiGate configuration settings and receive traps from the FortiGate SNMP agent. FortiManager systems require this MIB to monitor FortiGate units.</p>



MIB file name or RFC	Description
<b>RFC-1213 (MIB II)</b>	<p>The FortiGate SNMP agent supports MIB II groups with these exceptions.</p> <ul style="list-style-type: none"> <li>• No support for the EGP group from MIB II (RFC 1213, section 3.11 and 6.10).</li> <li>• Protocol statistics returned for MIB II groups (IP/ICMP/TCP/UDP/etc.) do not accurately capture all FortiGate traffic activity. More accurate information can be obtained from the information reported by the Fortinet MIB.</li> </ul>
<b>RFC-2665 (Ethernet-like MIB)</b>	<p>The FortiGate SNMP agent supports Ethernet-like MIB information. FortiGate SNMP does not support for the dot3Tests and dot3Errors groups.</p>

## SNMP get command syntax

Normally, to get configuration and status information for a FortiGate unit, an SNMP manager would use an SNMP get commands to get the information in a MIB field. The SNMP get command syntax would be similar to:

```
snmpget -v2c -c <community_name> <address_ipv4> {<OID> | <MIB_field>}
```

...where...

**<community\_name>** is an SNMP community name added to the FortiGate configuration. You can add more than one community name to a FortiGate SNMP configuration. The most commonly used community name is `public`.

**<address\_ipv4>** is the IP address of the FortiGate interface that the SNMP manager connects to.

**{<OID> | <MIB\_field>}** is the object identifier (OID) for the MIB field or the MIB field name itself.

The `SNMP get` command gets firmware version running on the FortiGate unit. The community name is `public`. The IP address of the interface configured for SNMP management access is `10.10.10.1`. The firmware version MIB field is `fgSysVersion` and the OID for this MIB field is `1.3.6.1.4.1.12356.101.4.1.1`. The first command uses the MIB field name and the second uses the OID:

```
snmpget -v2c -c public 10.10.10.1 fgSysVersion.0
snmpget -v2c -c public 10.10.10.1 1.3.6.1.4.1.12356.101.4.1.1.0
```



The OIDs and object names used in these examples are dependent on the version of MIB and are subject to change.

## VLANs

Virtual Local Area Networks (VLANs) multiply the capabilities of your FortiGate unit, and can also provide added network security. Virtual LANs (VLANs) use ID tags to logically separate devices on a network into smaller broadcast domains. These smaller domains forward packets only to devices that are part of that VLAN domain. This reduces traffic and increases network security.

A Local Area Network (LAN) is a group of connected computers and devices that are arranged into network broadcast domains. A LAN broadcast domain includes all the computers that receive a packet broadcast from any computer in that broadcast domain. A switch will automatically forward the packets to all of its ports; in contrast, routers do not automatically forward network broadcast packets. This means routers separate broadcast domains. If a network has only switches and no routers, that network is considered one broadcast domain, no matter how large or small it is. Smaller broadcast domains are more efficient because fewer devices receive unnecessary packets. They are more secure as well because a hacker reading traffic on the network will have access to only a small portion of the network instead of the entire network's traffic.

Virtual LANs (VLANs) use ID tags to logically separate a LAN into smaller broadcast domains. Each VLAN is its own broadcast domain. Smaller broadcast domains reduce traffic and increase network security. The IEEE 802.1Q standard defines VLANs. All layer-2 and layer-3 devices along a route must be 802.1Q-compliant to support VLANs along that route.

VLANs reduce the size of the broadcast domains by only forwarding packets to interfaces that are part of that VLAN or part of a VLAN trunk link. Trunk links form switch-to-switch or switch-to-router connections, and forward traffic for all VLANs. This enables a VLAN to include devices that are part of the same broadcast domain, but physically distant from each other.

VLAN ID tags consist of a 4-byte frame extension that switches and routers apply to every packet sent and received in the VLAN. Workstations and desktop computers, which are commonly originators or destinations of network traffic, are not an active part of the VLAN process. All the VLAN tagging and tag removal is done after the packet has left the computer.

Any FortiGate unit without VDOMs enabled can have a maximum of 255 interfaces in transparent operating mode. The same is true for any single VDOM. In NAT mode, the number can range from 255 to 8192 interfaces per VDOM, depending on the FortiGate model. These numbers include VLANs, other virtual interfaces, and physical interfaces. To have more than 255 interfaces configured in transparent operating mode, you need to configure multiple VDOMs that enable you to divide the total number of interfaces over all the VDOMs.

One example of an application of VLANs is a company's accounting department. Accounting computers may be located at both main and branch offices. However, accounting computers need to communicate with each other frequently and require increased security. VLANs allow the accounting network traffic to be sent only to accounting computers and to connect accounting computers in different locations as if they were on the same physical subnet.

This guide uses the term "packet" to refer to both layer-2 frames and layer-3 packets.

## VLAN ID rules

Layer-2 switches and layer-3 devices add VLAN ID tags to the traffic as it arrives and remove them before they deliver the traffic to its final destination. Devices such as PCs and servers on the network do not require any

special configuration for VLANs. Twelve bits of the 4-byte VLAN tag are reserved for the VLAN ID number. Valid VLAN ID numbers are from 1 to 4094, while 0 is used for high priority frames, and 4095 is reserved.

On a layer-2 switch, you can have only one VLAN subinterface per physical interface, unless that interface is configured as a trunk link. Trunk links can transport traffic for multiple VLANs to other parts of the network.

On a FortiGate unit, you can add multiple VLANs to the same physical interface. However, VLAN subinterfaces added to the same physical interface cannot have the same VLAN ID or have IP addresses on the same subnet. You can add VLAN subinterfaces with the same VLAN ID to different physical interfaces.

Creating VLAN subinterfaces with the same VLAN ID does not create any internal connection between them. For example a VLAN ID of 300 on port1 and VLAN ID of 300 on port2 are allowed, but they are not connected. Their relationship is the same as between any two FortiGate network interfaces.

## VLAN switching and routing

VLAN switching takes place on the OSI model layer-2, just like other network switching. VLAN routing takes place on the OSI model layer-3. The difference between them is that during VLAN switching, VLAN packets are simply forwarded to their destination. This is different from VLAN routing where devices can open the VLAN packets and change their VLAN ID tags to route the packets to a new destination.

### VLAN layer-2 switching

Ethernet switches are layer-2 devices, and generally are 802.1Q compliant. Layer 2 refers to the second layer of the seven layer Open Systems Interconnect (OSI) basic networking model; the Data Link layer. FortiGate units act as layer-2 switches or bridges when they are in transparent mode. The units simply tag and forward the VLAN traffic or receive and remove the tags from the packets. A layer-2 device does not inspect incoming packets or change their contents; it only adds or removes tags and routes the packet.

A VLAN can have any number of physical interfaces assigned to it. Multiple VLANs can be assigned to the same physical interface. Typically two or more physical interfaces are assigned to a VLAN, one for incoming and one for outgoing traffic. Multiple VLANs can be configured on one FortiGate unit, including trunk links.

#### Layer-2 VLAN example

To better understand VLAN operation, this example shows what happens to a data frame on a network that uses VLANs.

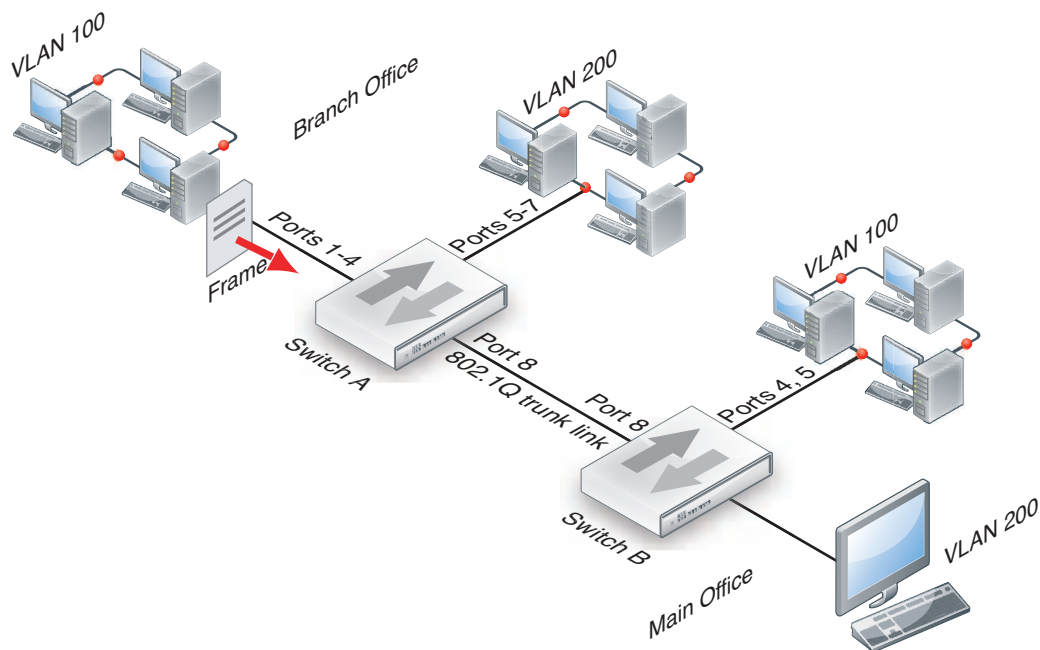
The network topology consists of two 8-port switches that are configured to support VLANs on a network. Both switches are connected through port 8 using an 802.1Q trunk link. Subnet 1 is connected to switch A, and subnet 2 is connected to switch B. The ports on the switches are configured as follows.

#### How ports and VLANs are used on Switch A and Switch B

Switch	Ports	VLAN
A	1 - 4	100
A	5 - 7	200

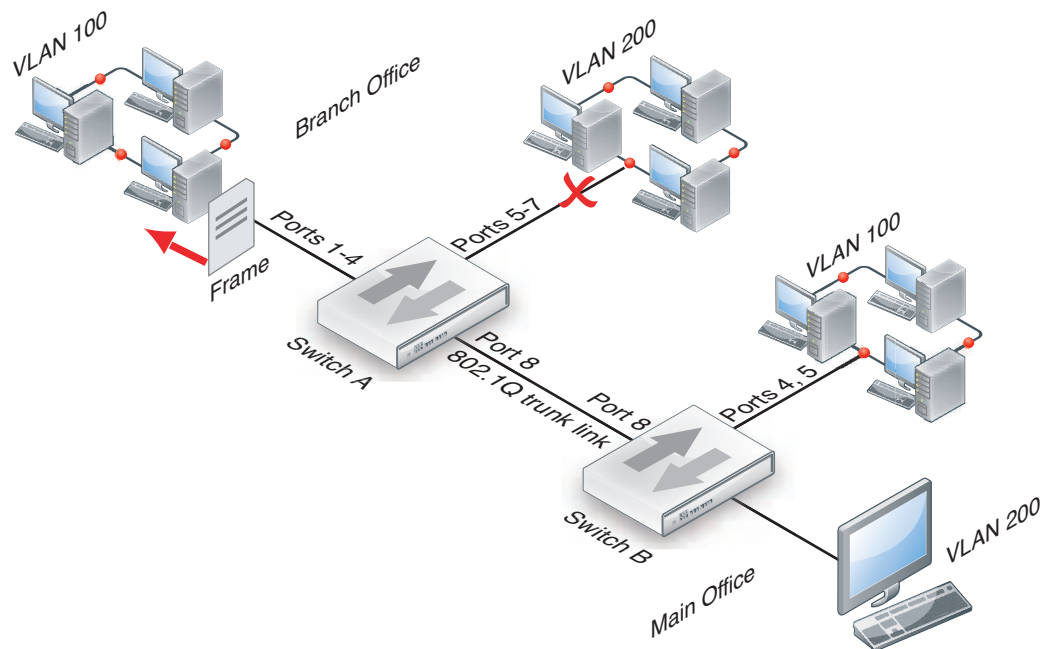
Switch	Ports	VLAN
A & B	8	Trunk link
B	4 - 5	100
B	6	200

In this example, switch A is connected to the Branch Office and switch B to the Main Office.



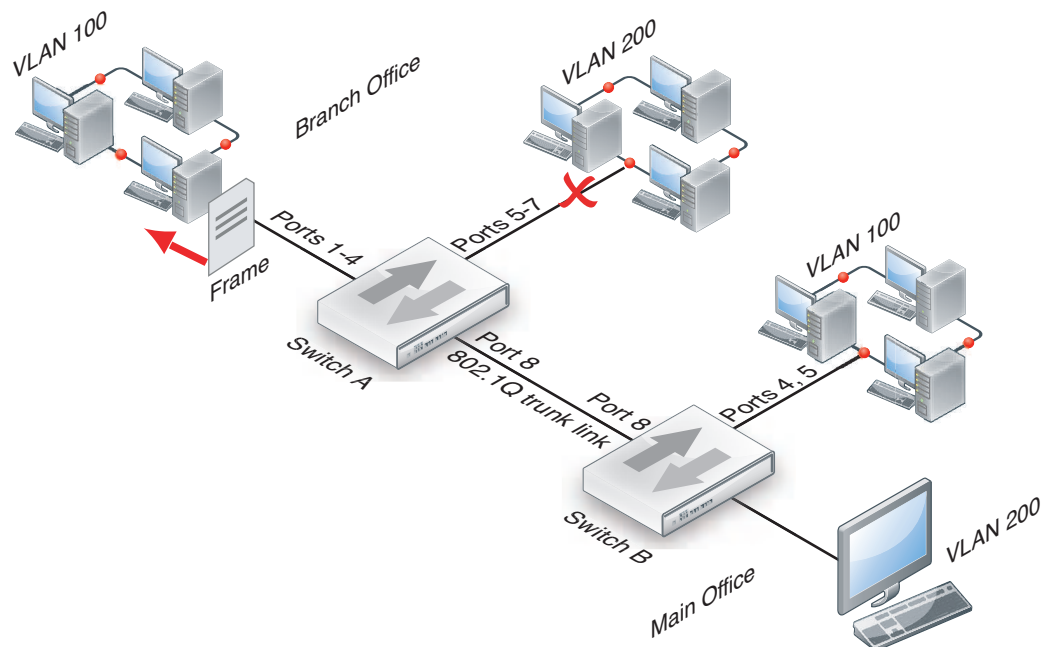
1. A computer on port 1 of switch A sends a data frame over the network.
2. Switch A tags the data frame with a VLAN 100 ID tag upon arrival because port 1 is part of VLAN 100.
3. Switch A forwards the tagged data frame to the other VLAN 100 ports — ports 2 through 4. Switch A also forwards the data frame to the 802.1Q trunk link (port 8) so other parts of the network that may contain VLAN 100 groups will receive VLAN 100 traffic.

This data frame is not forwarded to the other ports on switch A because they are not part of VLAN 100. This increases security and decreases network traffic.



4. Switch B receives the data frame over the trunk link (port 8).
5. Because there are VLAN 100 ports on switch B (ports 4 and 5), the data frame is forwarded to those ports. As with switch A, the data frame is not delivered to VLAN 200.

If there were no VLAN 100 ports on switch B, the switch would not forward the data frame and it would stop there.



6. The switch removes the VLAN 100 ID tag before it forwards the data frame to an end destination.

The sending and receiving computers are not aware of any VLAN tagging on the data frames that are being transmitted. When any computer receives that data frame, it appears as a normal data frame.

## VLAN layer-3 routing

Routers are layer-3 devices. Layer 3 refers to the third layer of the OSI networking model, the Network layer. FortiGate units in NAT mode act as layer-3 devices. As with layer 2, FortiGate units acting as layer-3 devices are 802.1Q-compliant.

The main difference between layer-2 and layer-3 devices is how they process VLAN tags. Layer-2 switches just add, read and remove the tags. They do not alter the tags or do any other high-level actions. Layer-3 routers not only add, read and remove tags but also analyze the data frame and its contents. This analysis allows layer-3 routers to change the VLAN tag if it is appropriate and send the data frame out on a different VLAN.

In a layer-3 environment, the 802.1Q-compliant router receives the data frame and assigns a VLAN ID. The router then forwards the data frame to other members of the same VLAN broadcast domain. The broadcast domain can include local ports, layer-2 devices and layer-3 devices such as routers and firewalls. When a layer-3 device receives the data frame, the device removes the VLAN tag and examines its contents to decide what to do with the data frame. The layer-3 device considers:

- Source and destination addresses
- Protocol
- Port number

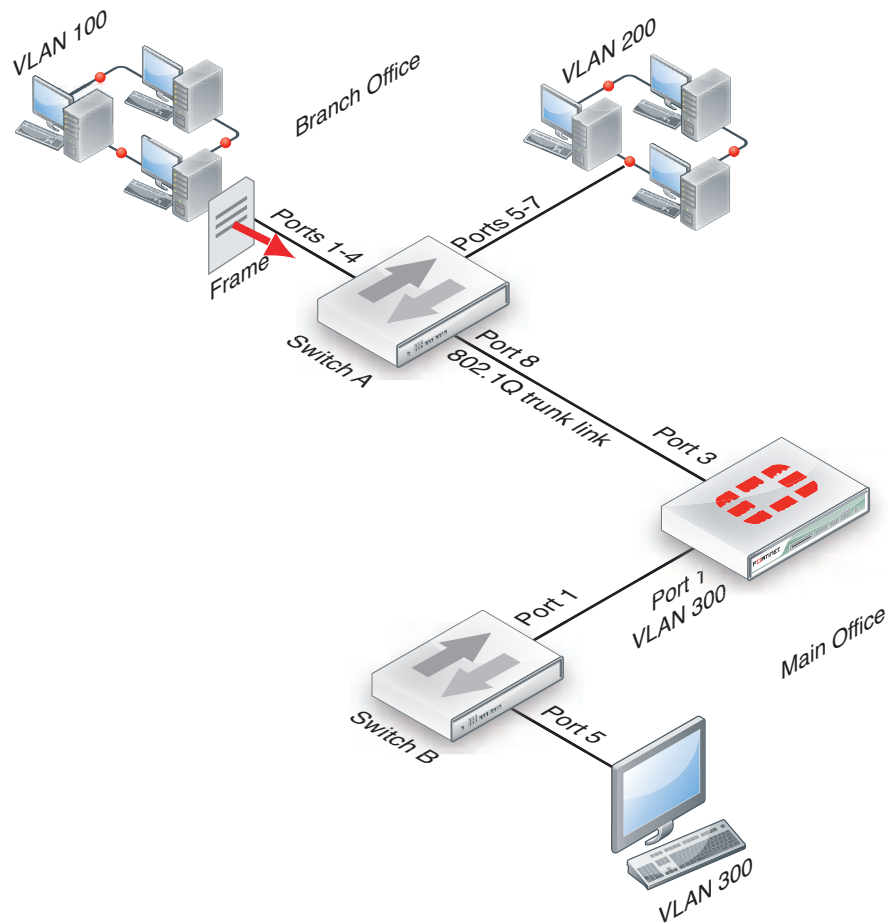
The data frame may be forwarded to another VLAN, sent to a regular non-VLAN-tagged network or just forwarded to the same VLAN as a layer-2 switch would do. Or, the data frame may be discarded if the proper security policy has been configured to do so.

### Layer-3 VLAN example

In this example, switch A is connected to the Branch Office subnet, the same as subnet 1 in the layer-2 example. In the Main Office subnet, VLAN 300 is on port 5 of switch B. The FortiGate unit is connected to switch B on port 1 and the trunk link connects the FortiGate unit's port 3 to switch A. The other ports on switch B are unassigned.

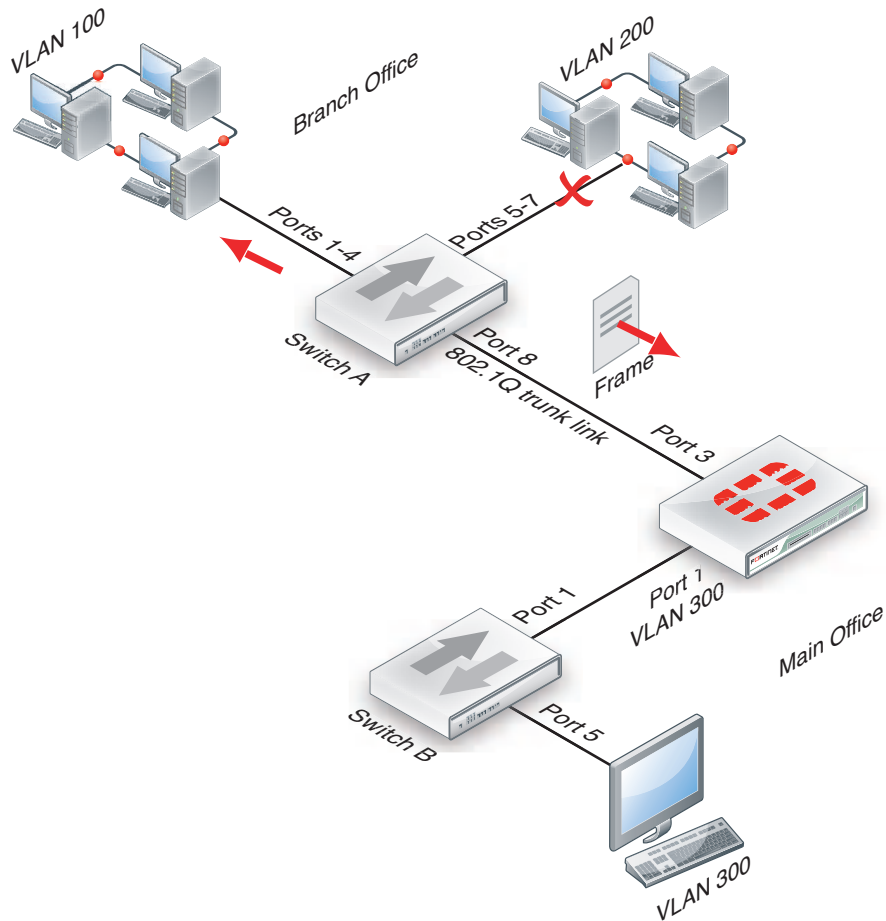
This example explains how traffic can change VLANs originating on VLAN 100 and arriving at a destination on VLAN 300. Layer-2 switches alone cannot accomplish this, but a layer-3 router can.

1. The VLAN 100 computer at the Branch Office sends the data frame to switch A, where the VLAN 100 tag is added.



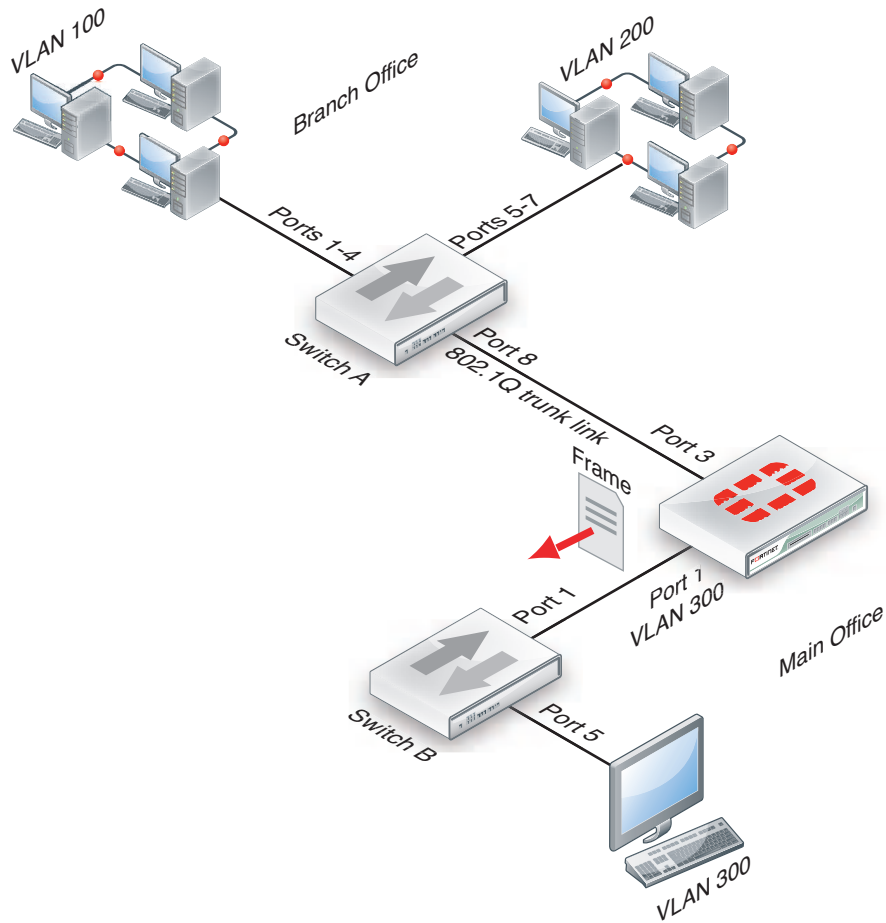
2. Switch A forwards the tagged data frame to the FortiGate unit over the 802.1Q trunk link, and to the VLAN 100 interfaces on Switch A.

Up to this point everything is the same as in the layer-2 example.

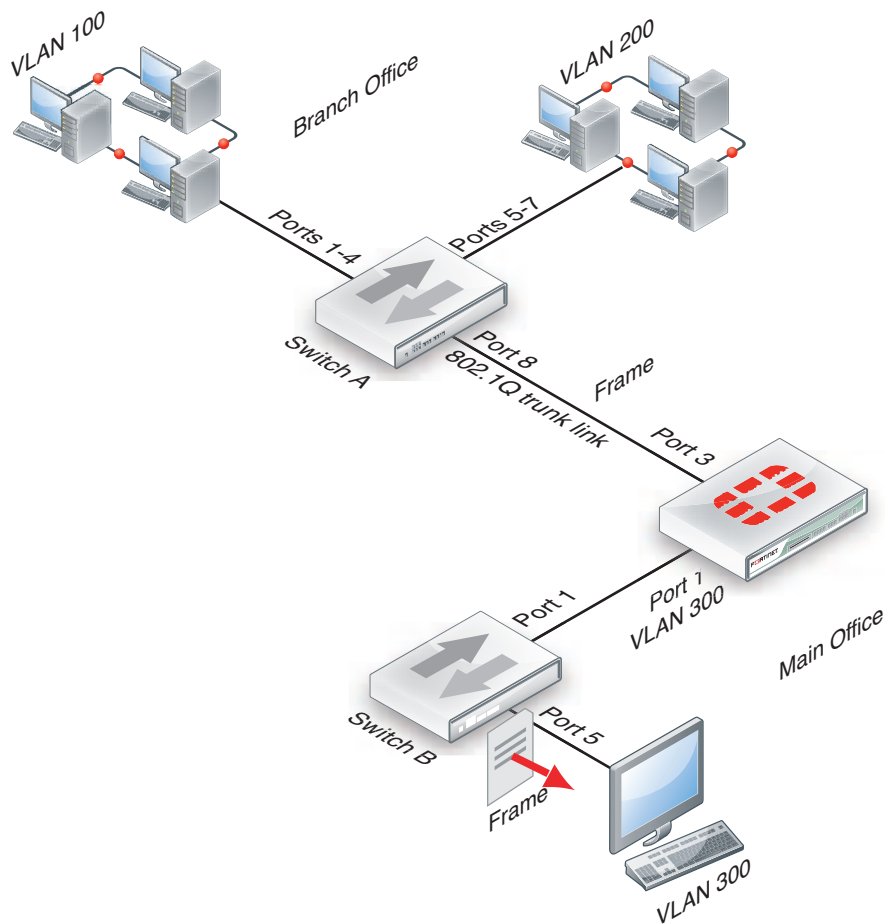


3. The FortiGate unit removes the VLAN 100 tag, and inspects the content of the data frame. The FortiGate unit uses the content to select the correct security policy and routing options.
4. The FortiGate unit's security policy allows the data frame to go to VLAN 300 in this example. The data frame will be sent to all VLAN 300 interfaces, but in the example there is only port 1 on the FortiGate unit. Before the data frame leaves, the FortiGate unit adds the VLAN ID 300 tag to the data frame.  
This is the step that layer 2 cannot do. Only layer 3 can retag a data frame as a different VLAN.





5. Switch B receives the data frame, and removes the VLAN ID 300 tag, because this is the last hop, and forwards the data frame to the computer on port 5.



In this example, a data frame arrived at the FortiGate unit tagged as VLAN 100. After checking its content, the FortiGate unit retagged the data frame for VLAN 300. It is this change from VLAN 100 to VLAN 300 that requires a layer-3 routing device, in this case the FortiGate unit. Layer-2 switches cannot perform this change.

## VLANs in NAT mode

In NAT mode the FortiGate unit functions as a layer-3 device. In this mode, the FortiGate unit controls the flow of packets between VLANs, but can also remove VLAN tags from incoming VLAN packets. The FortiGate unit can also forward untagged packets to other networks, such as the Internet.

In NAT mode, the FortiGate unit supports VLAN trunk links with IEEE 802.1Q-compliant switches, or routers. The trunk link transports VLAN-tagged packets between physical subnets or networks. When you add VLAN sub-interfaces to the FortiGate unit physical interfaces, the VLANs have IDs that match the VLAN IDs of packets on the trunk link. The FortiGate unit directs packets with VLAN IDs to sub-interfaces with matching IDs.

You can define VLAN sub-interfaces on all FortiGate physical interfaces. However, if multiple virtual domains are configured on the FortiGate unit, you will have access to only the physical interfaces on your virtual domain. The FortiGate unit can tag packets leaving on a VLAN subinterface. It can also remove VLAN tags from incoming packets and add a different VLAN tag to outgoing packets.

Normally in VLAN configurations, the FortiGate unit's internal interface is connected to a VLAN trunk, and the external interface connects to an Internet router that is not configured for VLANs. In this configuration the FortiGate unit can apply different policies for traffic on each VLAN interface connected to the internal interface, which results in less network traffic and better security.

## Adding VLAN subinterfaces

A VLAN subinterface, also called a VLAN, is a virtual interface on a physical interface. The subinterface allows routing of VLAN tagged packets using that physical interface, but it is separate from any other traffic on the physical interface.

Adding a VLAN subinterface includes configuring:

- Physical interface
- IP address and netmask
- VLAN ID
- VDOM

### Physical interface

The term VLAN subinterface correctly implies the VLAN interface is not a complete interface by itself. You add a VLAN subinterface to the physical interface that receives VLAN-tagged packets. The physical interface can belong to a different VDOM than the VLAN, but it must be connected to a network router that is configured for this VLAN. Without that router, the VLAN will not be connected to the network, and VLAN traffic will not be able to access this interface. The traffic on the VLAN is separate from any other traffic on the physical interface.

When you are working with interfaces on your FortiGate unit, use the **Column Settings** on the Interface display to make sure the information you need is displayed. When working with VLANs, it is useful to position the **VLAN ID** column close to the IP address. If you are working with VDOMs, including the **Virtual Domain** column as well will help you troubleshoot problems more quickly.

To view the Interface display, go to **System > Network > Interface**.

### IP address and netmask

FortiGate unit interfaces cannot have overlapping IP addresses. The IP addresses of all interfaces must be on different subnets. This rule applies to both physical interfaces and to virtual interfaces such as VLAN subinterfaces. Each VLAN subinterface must be configured with its own IP address and netmask pair. This rule helps prevent a broadcast storm or other similar network problems.



If you are unable to change your existing configurations to prevent IP overlap, enter the CLI command `config system settings and set allow-subnet-overlap enable` to allow IP address overlap. If you enter this command, multiple VLAN interfaces can have an IP address that is part of a subnet used by another interface. This command is recommended for advanced users only.

### VLAN ID

The VLAN ID is part of the VLAN tag added to the packets by VLAN switches and routers. The VLAN ID is a number between 1 and 4094 that allow groups of IP addresses with the same VLAN ID to be associated together. VLAN ID 0 is used only for high priority frames, and 4095 is reserved.

All devices along a route must support the VLAN ID of the traffic along that route. Otherwise, the traffic will be discarded before reaching its destination. For example, if your computer is part of VLAN\_100 and a co-worker on a different floor of your building is also on the same VLAN\_100, you can communicate with each other over VLAN\_100, only if all the switches and routers support VLANs and are configured to pass along VLAN\_100 traffic properly. Otherwise, any traffic you send your co-worker will be blocked or not delivered.

## VDOM

If VDOMs are enabled, each VLAN subinterface must belong to a VDOM. This rule also applies for physical interfaces.



Interface-related CLI commands require a VDOM to be specified, regardless of whether the FortiGate unit has VDOMs enabled.

VLAN subinterfaces on separate VDOMs cannot communicate directly with each other. In this situation, the VLAN traffic must exit the FortiGate unit and re-enter the unit again, passing through firewalls in both directions. This situation is the same for physical interfaces.

A VLAN subinterface can belong to a different VDOM than the physical interface it is part of. This is because the traffic on the VLAN is handled separately from the other traffic on that interface. This is one of the main strengths of VLANs.

The following procedure will add a VLAN subinterface called `VLAN_100` to the FortiGate internal interface with a VLAN ID of 100. It will have an IP address and netmask of `172.100.1.1/255.255.255.0`, and allow HTTPS, PING, and Telnet administrative access. Note that in the CLI, you must enter “`set type vlan`” before setting the `vlanid`, and that the `allowaccess` protocols are lower case.

### To add a VLAN subinterface in NAT mode - web-based manager

1. If **Current VDOM** appears at the bottom left of the screen, select **Global** from the list of VDOMs.
2. Go to **System > Network > Interface**.
3. Select **Create New** to add a VLAN subinterface.
4. Enter the following:

<b>VLAN Name</b>	VLAN_100
<b>Type</b>	VLAN
<b>Interface</b>	internal
<b>VLAN ID</b>	100
<b>Addressing Mod</b>	Manual
<b>IP/Netmask</b>	172.100.1.1/255.255.255.0
<b>Administrative Access</b>	HTTPS, PING, TELNET

5. Select **OK**.

To view the new VLAN subinterface, select the expand arrow next to the parent physical interface (the internal interface). This will expand the display to show all VLAN subinterfaces on this physical interface. If there is no expand arrow displayed, there are no subinterfaces configured on that physical interface.

For each VLAN, the list displays the name of the VLAN, and, depending on column settings, its IP address, the Administrative access you selected for it, the VLAN ID number, and which VDOM it belongs to if VDOMs are enabled.

### To add a VLAN subinterface in NAT mode - CLI

```
config system interface
edit VLAN_100
set interface internal
set type vlan
set vlanid 100
set ip 172.100.1.1 255.255.255.0
set allowaccess https ping telnet
end
```

## Configuring security policies and routing

Once you have created a VLAN subinterface on the FortiGate unit, you need to configure security policies and routing for that VLAN. Without these, the FortiGate unit will not pass VLAN traffic to its intended destination. Security policies direct traffic through the FortiGate unit between interfaces. Routing directs traffic across the network.

### Configuring security policies

Security policies permit communication between the FortiGate unit's network interfaces based on source and destination IP addresses. Interfaces that communicate with the VLAN interface need security policies to permit traffic to pass between them and the VLAN interface.

Each VLAN needs a security policy for each of the following connections the VLAN will be using:

- From this VLAN to an external network
- From an external network to this VLAN
- From this VLAN to another VLAN in the same virtual domain on the FortiGate unit
- From another VLAN to this VLAN in the same virtual domain on the FortiGate unit.

The packets on each VLAN are subject to antivirus scans and other UTM measures as they pass through the FortiGate unit.

### Configuring routing

As a minimum, you need to configure a default static route to a gateway with access to an external network for outbound packets. In more complex cases, you will have to configure different static or dynamic routes based on packet source and destination addresses.

As with firewalls, you need to configure routes for VLAN traffic. VLANs need routing and a gateway configured to send and receive packets outside their local subnet just as physical interfaces do. The type of routing you configure, static or dynamic, will depend on the routing used by the subnet and interfaces you are connecting to. Dynamic routing can be routing information protocol (RIP), border gateway protocol (BGP), open shortest path first (OSPF), or multicast.

If you enable SSH, PING, Telnet, HTTPS and HTTP on the VLAN, you can use those protocols to troubleshoot your routing and test that it is properly configured. Enabling logging on the interfaces and using CLI diagnose commands such as `diagnose sniff packet <interface_name>` can also help locate any possible configuration or hardware issues.

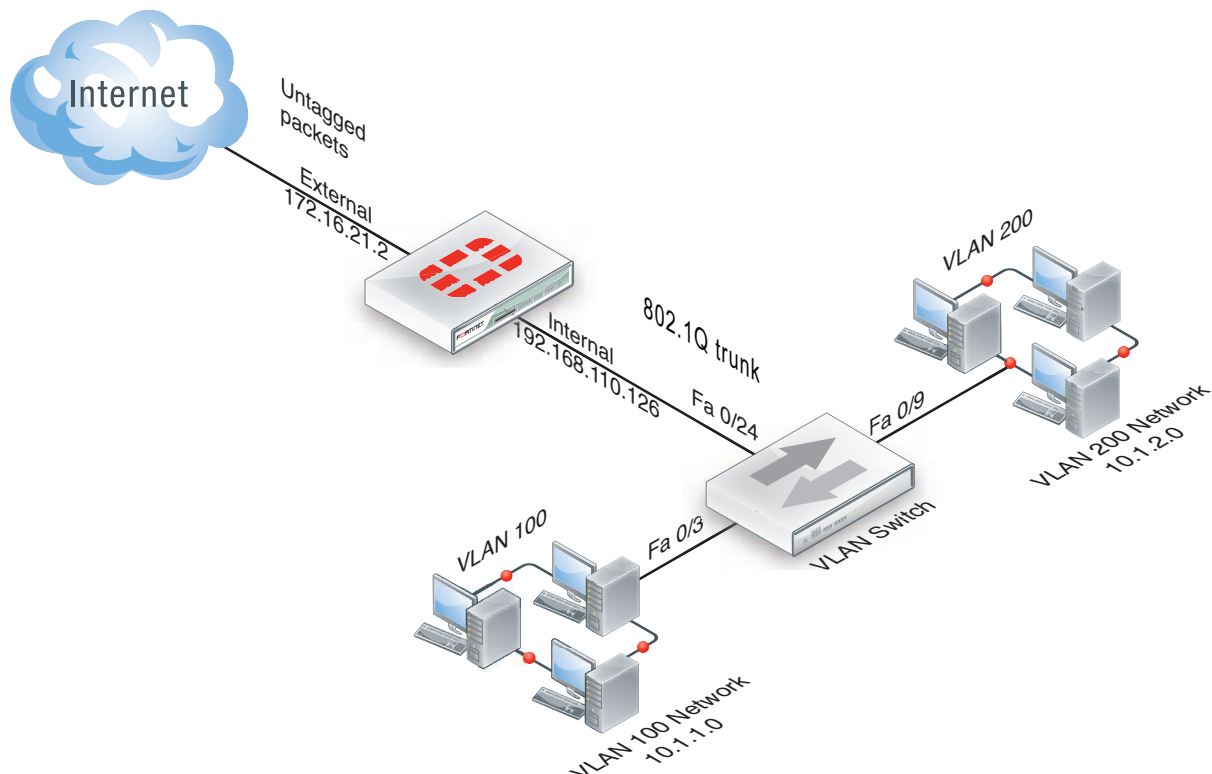
## Example VLAN configuration in NAT mode

In this example two different internal VLAN networks share one interface on the FortiGate unit, and share the connection to the Internet. This example shows that two networks can have separate traffic streams while sharing a single interface. This configuration could apply to two departments in a single company, or to different companies.

There are two different internal network VLANs in this example. VLAN\_100 is on the 10.1.1.0/255.255.255.0 subnet, and VLAN\_200 is on the 10.1.2.0/255.255.255.0 subnet. These VLANs are connected to the VLAN switch, such as a Cisco 2950 Catalyst switch.

The FortiGate internal interface connects to the VLAN switch through an 802.1Q trunk. The internal interface has an IP address of 192.168.110.126 and is configured with two VLAN subinterfaces (VLAN\_100 and VLAN\_200). The external interface has an IP address of 172.16.21.2 and connects to the Internet. The external interface has no VLAN subinterfaces.

### FortiGate unit with VLANs in NAT mode



When the VLAN switch receives packets from VLAN\_100 and VLAN\_200, it applies VLAN ID tags and forwards the packets of each VLAN both to local ports and to the FortiGate unit across the trunk link. The FortiGate unit has policies that allow traffic to flow between the VLANs, and from the VLANs to the external network.

This section describes how to configure a FortiGate unit and a Cisco Catalyst 2950 switch for this example network topology. The Cisco configuration commands used in this section are IOS commands.

It is assumed that both the FortiGate unit and the Cisco 2950 switch are installed and connected and that basic configuration has been completed. On the switch, you will need to be able to access the CLI to enter commands. Refer to the manual for your FortiGate model as well as the manual for the switch you select for more information.

It is also assumed that no VDOMs are enabled.

## General configuration steps

The following steps provide an overview of configuring and testing the hardware used in this example. For best results in this configuration, follow the procedures in the order given. Also, note that if you perform any additional actions between procedures, your configuration may have different results.

1. Configure the FortiGate unit
  - Configure the external interface
  - Add two VLAN subinterfaces to the internal network interface
  - Add firewall addresses and address ranges for the internal and external networks
  - Add security policies to allow:
    - the VLAN networks to access each other
    - the VLAN networks to access the external network.
2. Configure the VLAN switch

## Configure the FortiGate unit

Configuring the FortiGate unit includes:

### Configure the external interface

The FortiGate unit's external interface will provide access to the Internet for all internal networks, including the two VLANs.

#### To configure the external interface - web-based manager

1. Go to **System > Network > Interface**.
2. Select **Edit** for the external interface.
3. Enter the following information and select **OK**:

<b>Addressing mode</b>	Manual
<b>IP/Network Mask</b>	172.16.21.2/255.255.255.0

#### To configure the external interface - CLI

```
config system interface
```

```
edit external
    set mode static
    set ip 172.16.21.2 255.255.255.0
end
```

## Add VLAN subinterfaces

This step creates the VLANs on the FortiGate unit internal physical interface. The IP address of the internal interface does not matter to us, as long as it does not overlap with the subnets of the VLAN subinterfaces we are configuring on it.

The rest of this example shows how to configure the VLAN behavior on the FortiGate unit, configure the switches to direct VLAN traffic the same as the FortiGate unit, and test that the configuration is correct.

Adding VLAN subinterfaces can be completed through the web-based manager, or the CLI.

### To add VLAN subinterfaces - web-based manager

1. Go to **System > Network > Interface**.
2. Select **Create New**.
3. Enter the following information and select **OK**:

<b>Name</b>	VLAN_100
<b>Interface</b>	internal
<b>VLAN ID</b>	100
<b>Addressing mode</b>	Manual
<b>IP/Network Mask</b>	10.1.1.1/255.255.255.0
<b>Administrative Access</b>	HTTPS, PING, TELNET

4. Select **Create New**.
5. Enter the following information and select **OK**:

<b>Name</b>	VLAN_200
<b>Interface</b>	internal
<b>VLAN ID</b>	200
<b>Addressing mode</b>	Manual
<b>IP/Network Mask</b>	10.1.2.1/255.255.255.0
<b>Administrative Access</b>	HTTPS, PING, TELNET

### To add VLAN subinterfaces - CLI

```
config system interface
    edit VLAN_100
        set vdom root
        set interface internal
```



```

        set type vlan
        set vlanid 100
        set mode static
        set ip 10.1.1.1 255.255.255.0
        set allowaccess https ping telnet
    next
    edit VLAN_200
        set vdom root
        set interface internal
        set type vlan
        set vlanid 200
        set mode static
        set ip 10.1.2.1 255.255.255.0
        set allowaccess https ping telnet
end

```

## Add the firewall addresses

You need to define the addresses of the VLAN subnets for use in security policies. The FortiGate unit provides one default address, “all”, that you can use when a security policy applies to all addresses as a source or destination of a packet. However, using “all” is less secure and should be avoided when possible.

In this example, the “\_Net” part of the address name indicates a range of addresses instead of a unique address. When choosing firewall address names, use informative and unique names.

### To add the firewall addresses - web-based manager

1. Go to **Firewall Objects > Address > Addresses**.
2. Select **Create New**.
3. Enter the following information and select **OK**:

<b>Name</b>	VLAN_100_Net
<b>Type</b>	Subnet
<b>Subnet / IP Range</b>	10.1.1.0/255.255.255.0

4. Select **Create New**.
5. Enter the following information and select **OK**:

<b>Name</b>	VLAN_200_Net
<b>Type</b>	Subnet
<b>Subnet / IP Range</b>	10.1.2.0/255.255.255.0

### To add the firewall addresses - CLI

```

config firewall address
    edit VLAN_100_Net
        set type ipmask
        set subnet 10.1.1.0 255.255.255.0
    next
    edit VLAN_200_Net

```

```

set type ipmask
set subnet 10.1.2.0 255.255.255.0
end

```

## Add the security policies

Once you have assigned addresses to the VLANs, you need to configure security policies for them to allow valid packets to pass from one VLAN to another and to the Internet.



You can customize the Security Policy display by including some or all columns, and customize the column order onscreen. Due to this feature, security policy screenshots may not appear the same as on your screen.

If you do not want to allow all services on a VLAN, you can create a security policy for each service you want to allow. This example allows all services.

### To add the security policies - web-based manager

1. Go to **Policy & Objects > Policy > IPv4** or **Policy & Objects > Policy > IPv6** and select **Create New**.
2. Leave the **Policy Type** as **Firewall** and the **Policy Subtype** as **Address**.
3. Enter the following information and select **OK**:

<b>Incoming Interface</b>	VLAN_100
<b>Source Address</b>	VLAN_100_Net
<b>Outgoing Interface</b>	VLAN_200
<b>Destination Address</b>	VLAN_200_Net
<b>Schedule</b>	Always
<b>Service</b>	ALL
<b>Action</b>	ACCEPT
<b>Enable NAT</b>	Enable

4. Select **Create New**.
5. Leave the **Policy Type** as **Firewall** and the **Policy Subtype** as **Address**.
6. Enter the following information and select **OK**:

<b>Incoming Interface</b>	VLAN_200
<b>Source Address</b>	VLAN_200_Net
<b>Outgoing Interface</b>	VLAN_100
<b>Destination Address</b>	VLAN_100_Net

<b>Schedule</b>	Always
<b>Service</b>	ALL
<b>Action</b>	ACCEPT
<b>Enable NAT</b>	Enable

7. Select **Create New**.
8. Leave the **Policy Type** as **Firewall** and the **Policy Subtype** as **Address**.
9. Enter the following information and select **OK**:

<b>Incoming Interface</b>	VLAN_100
<b>Source Address</b>	VLAN_100_Net
<b>Outgoing Interface</b>	external
<b>Destination Address</b>	all
<b>Schedule</b>	Always
<b>Service</b>	ALL
<b>Action</b>	ACCEPT
<b>Enable NAT</b>	Enable

10. Select **Create New**.
11. Verify that the **Policy Type** is **Firewall** and the **Policy Subtype** is **Address**.
12. Enter the following information and select **OK**:

<b>Incoming Interface</b>	VLAN_200
<b>Source Address</b>	VLAN_200_Net
<b>Outgoing Interface</b>	external
<b>Destination Address</b>	all
<b>Schedule</b>	Always
<b>Service</b>	ALL
<b>Action</b>	ACCEPT
<b>Enable NAT</b>	Enable

### To add the security policies - CLI

```
config firewall policy or Config firewall policy6
edit 1
set srcintf VLAN_100
set srcaddr VLAN_100_Net
```

```
        set dstintf VLAN_200
        set dstaddr VLAN_200_Net
        set schedule always
        set service ALL
        set action accept
        set nat enable
        set status enable
    next
edit 2
    set srcintf VLAN_200
    set srcaddr VLAN_200_Net
    set dstintf VLAN_100
    set dstaddr VLAN_100_Net
    set schedule always
    set service ALL
    set action accept
    set nat enable
    set status enable
next
edit 3
    set srcintf VLAN_100
    set srcaddr VLAN_100_Net
    set dstintf external
    set dstaddr all
    set schedule always
    set service ALL
    set action accept
    set nat enable
    set status enable
next
edit 4
    set srcintf VLAN_200
    set srcaddr VLAN_200_Net
    set dstintf external
    set dstaddr all
    set schedule always
    set service ALL
    set action accept
    set nat enable
    set status enable
end
```

## Configure the VLAN switch

On the Cisco Catalyst 2950 Catalyst VLAN switch, you need to define VLANs 100 and 200 in the VLAN database, and then add a configuration file to define the VLAN subinterfaces and the 802.1Q trunk interface.

One method to configure a Cisco switch is to connect over a serial connection to the console port on the switch, and enter the commands at the CLI. Another method is to designate one interface on the switch as the management interface and use a web browser to connect to the switch's graphical interface. For details on connecting and configuring your Cisco switch, refer to the installation and configuration manuals for the switch.

The switch used in this example is a Cisco Catalyst 2950 switch. The commands used are IOS commands. Refer to the switch manual for help with these commands.

### To configure the VLAN subinterfaces and the trunk interfaces

Add this file to the Cisco switch:

```
!  
interface FastEthernet0/3  
switchport access vlan 100  
!  
interface FastEthernet0/9  
switchport access vlan 200  
!  
interface FastEthernet0/24  
switchport trunk encapsulation dot1q  
switchport mode trunk  
!
```

The switch has the configuration:

<b>Port 0/3</b>	VLAN ID 100
<b>Port 0/9</b>	VLAN ID 200
<b>Port 0/24</b>	802.1Q trunk



To complete the setup, configure devices on VLAN\_100 and VLAN\_200 with default gateways. The default gateway for VLAN\_100 is the FortiGate VLAN\_100 subinterface. The default gateway for VLAN\_200 is the FortiGate VLAN\_200 subinterface.

## Test the configuration

Use diagnostic commands, such as `tracert`, to test traffic routed through the FortiGate unit and the Cisco switch.

### Testing traffic from VLAN\_100 to VLAN\_200

In this example, a route is traced between the two internal networks. The route target is a host on VLAN\_200.

Access a command prompt on a Windows computer on the VLAN\_100 network, and enter the following command:

```
C:\>tracert 10.1.2.2  
Tracing route to 10.1.2.2 over a maximum of 30 hops:  
  1 <10 ms <10 ms <10 ms 10.1.1.1  
  2 <10 ms <10 ms <10 ms 10.1.2.2  
Trace complete.
```

### Testing traffic from VLAN\_200 to the external network

In this example, a route is traced from an internal network to the external network. The route target is the external network interface of the FortiGate-800 unit.

From VLAN\_200, access a command prompt and enter this command:

```
C:\>tracert 172.16.21.2
Tracing route to 172.16.21.2 over a maximum of 30 hops:
  1 <10 ms <10 ms <10 ms 10.1.2.1
  2 <10 ms <10 ms <10 ms 172.16.21.2
Trace complete.
```

## VLANs in transparent mode

In transparent mode, the FortiGate unit behaves like a layer-2 bridge but can still provide services such as antivirus scanning, web filtering, spam filtering and intrusion protection to traffic. There are some limitations in transparent mode in that you cannot use SSL VPN, PPTP/L2TP VPN, DHCP server, or easily perform NAT on traffic. The limits in transparent mode apply to IEEE 802.1Q VLAN trunks passing through the unit.

## VLANs and transparent mode

You can insert the FortiGate unit operating in transparent mode into the VLAN trunk without making changes to your network. In a typical configuration, the FortiGate unit internal interface accepts VLAN packets on a VLAN trunk from a VLAN switch or router connected to internal network VLANs. The FortiGate external interface forwards VLAN-tagged packets through another VLAN trunk to an external VLAN switch or router and on to external networks such as the Internet. You can configure the unit to apply different policies for traffic on each VLAN in the trunk.

To pass VLAN traffic through the FortiGate unit, you add two VLAN subinterfaces with the same VLAN ID, one to the internal interface and the other to the external interface. You then create a security policy to permit packets to flow from the internal VLAN interface to the external VLAN interface. If required, you create another security policy to permit packets to flow from the external VLAN interface to the internal VLAN interface. Typically in transparent mode, you do not permit packets to move between different VLANs. Network protection features, such as spam filtering, web filtering and anti-virus scanning, are applied through the UTM profiles specified in each security policy, enabling very detailed control over traffic.

When the FortiGate unit receives a VLAN-tagged packet at a physical interface, it directs the packet to the VLAN subinterface with the matching VLAN ID. The VLAN tag is removed from the packet, and the FortiGate unit then applies security policies using the same method it uses for non-VLAN packets. If the packet exits the FortiGate unit through a VLAN subinterface, the VLAN ID for that subinterface is added to the packet and the packet is sent to the corresponding physical interface.

There are two essential steps to configure your FortiGate unit to work with VLANs in transparent mode:

- [Add VLAN subinterfaces](#)
- [Create security policies](#)

You can also configure the protection profiles that manage antivirus scanning, web filtering and spam filtering. For more information on UTM profiles, see the UTM Guide.

### Add VLAN subinterfaces

The VLAN ID of each VLAN subinterface must match the VLAN ID added by the IEEE 802.1Q-compliant router or switch. The VLAN ID can be any number between 1 and 4094, with 0 being used only for high priority frames and 4095 being reserved. You add VLAN subinterfaces to the physical interface that receives VLAN-tagged packets.

For this example, we are creating a VLAN called `internal_v225` on the internal interface, with a VLAN ID of 225. Administrative access is enabled for HTTPS and SSH. VDOMs are not enabled.

### To add VLAN subinterfaces in transparent mode - web-based manager

1. Go to **System > Network > Interface**.
2. Select **Create New**.
3. Enter the following information and select **OK**.

<b>Name</b>	internal_v225
<b>Type</b>	VLAN
<b>Interface</b>	internal
<b>VLAN ID</b>	225
<b>Administrative Access</b>	Enable HTTPS, and SSH. These are very secure access methods.
<b>Comments</b>	VLAN 225 on internal interface

The FortiGate unit adds the new subinterface to the interface that you selected.

Repeat steps 2 and 3 to add additional VLANs. You will need to change the **VLAN ID**, **Name**, and possibly **Interface** when adding additional VLANs.

### To add VLAN subinterfaces in transparent mode - CLI

```
config system interface
  edit internal_v225
    set interface internal
    set vlanid 225
    set allowaccess HTTPS SSH
    set description "VLAN 225 on internal interface"
    set vdom root
  end
```

## Create security policies

In transparent mode, the FortiGate unit performs antivirus and antispam scanning on each VLAN's packets as they pass through the unit. You need security policies to permit packets to pass from the VLAN interface where they enter the unit to the VLAN interface where they exit the unit. If there are no security policies configured, no packets will be allowed to pass from one interface to another.

### To add security policies for VLAN subinterfaces - web based manager

1. Go to **Policy & Objects > Objects > Addresses**.
2. Select **Create New** to add firewall addresses that match the source and destination IP addresses of VLAN packets.
3. Go to **Policy & Objects > Policy > IPv4** or **Policy & Objects > Policy > IPv6** and select **Create New**.
4. From the **Incoming Interface/Zone** list, select the VLAN interface where packets enter the unit.
5. From the **Outgoing Interface/Zone** list, select the VLAN interface where packets exit the unit.
6. Select the **Source** and **Destination Address** names that you added in step 2.
7. Select **OK**.

### To add security policies for VLAN subinterfaces - CLI

```

config firewall address
  edit incoming_VLAN_address
    set associated-interface <incoming_VLAN_interface>
    set type ipmask
    set subnet <IPv4_address_mask>
  next
  edit outgoing_VLAN_address
    set associated-interface <outgoing_VLAN_interface>
    set type ipmask
    set subnet <IPv4_address_mask>
  next
end
config firewall policy or config firewall policy6
  edit <unused_policy_number>
    set srcintf <incoming_VLAN_interface>
    set srcaddr incoming_VLAN_address
    set destintf <outgoing_VLAN_interface>
    set destaddr outgoing_VLAN_address
    set schedule always
    set service <protocol_to_allow_on_VLAN>
    set action ACCEPT
  next
end

```

### Example of VLANs in transparent mode

In this example, the FortiGate unit is operating in transparent mode and is configured with two VLANs: one with an ID of 100 and the other with ID 200. The internal and external physical interfaces each have two VLAN subinterfaces, one for VLAN\_100 and one for VLAN\_200.

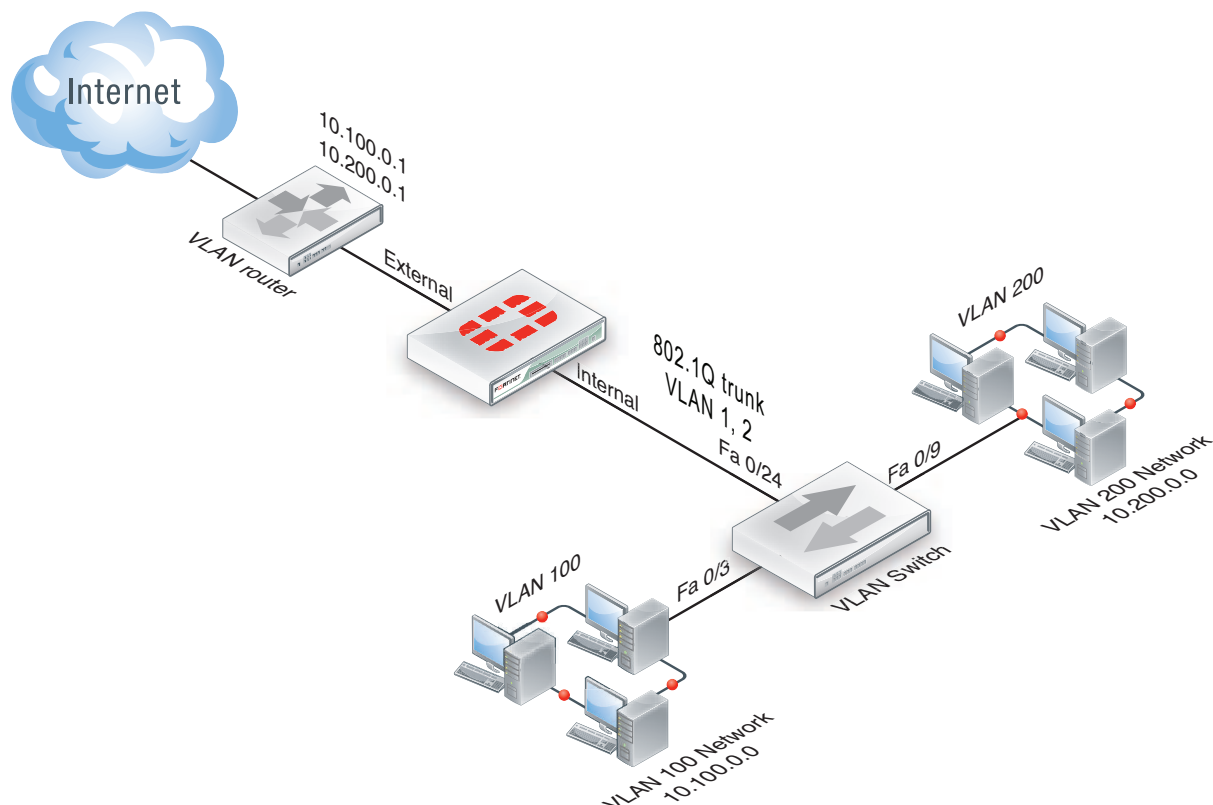
The IP range for the internal VLAN\_100 network is 10.100.0.0/255.255.0.0, and for the internal VLAN\_200 network is 10.200.0.0/255.255.0.0.

The internal networks are connected to a Cisco 2950 VLAN switch, which combines traffic from the two VLANs onto one in the FortiGate unit internal interface. The VLAN traffic leaves the FortiGate unit on the external network interface, goes on to the VLAN switch, and on to the Internet. When the FortiGate unit receives a tagged packet, it directs it from the incoming VLAN subinterface to the outgoing VLAN subinterface for that VLAN.

This section describes how to configure a FortiGate-800 unit, Cisco switch, and Cisco router in the network topology shown below.



### VLAN transparent network topology



### General configuration steps

The following steps summarize the configuration for this example. For best results, follow the procedures in the order given. Also, note that if you perform any additional actions between procedures, your configuration may have different results.

1. Configure the FortiGate unit which includes
  - Adding VLAN subinterfaces
  - Adding the security policies
2. Configure the Cisco switch and router

### Configure the FortiGate unit

The FortiGate unit must be configured with the VLAN subinterfaces and the proper security policies to enable traffic to flow through the FortiGate unit.

#### Add VLAN subinterfaces

For each VLAN, you need to create a VLAN subinterface on the internal interface and another one on the external interface, both with the same VLAN ID.

**To add VLAN subinterfaces - web-based manager**

1. Go to **System > Network > Interface**.
2. Select **Create New**.
3. Enter the following information and select **OK**:

<b>Name</b>	VLAN_100_int
<b>Interface</b>	internal
<b>VLAN ID</b>	100

4. Select **Create New**.
5. Enter the following information and select **OK**:

<b>Name</b>	VLAN_100_ext
<b>Interface</b>	external
<b>VLAN ID</b>	100

6. Select **Create New**.
7. Enter the following information and select **OK**:

<b>Name</b>	VLAN_200_int
<b>Interface</b>	internal
<b>VLAN ID</b>	200

8. Select **Create New**.
9. Enter the following information and select **OK**:

<b>Name</b>	VLAN_200_ext
<b>Interface</b>	external
<b>VLAN ID</b>	200

**To add VLAN subinterfaces - CLI**

```
config system interface
  edit VLAN_100_int
    set status down
    set type vlan
    set interface internal
    set vlanid 100
  next
  edit VLAN_100_ext
    set status down
    set type vlan
```

```

        set interface external
        set vlanid 100
    next
    edit VLAN_200_int
        set status down
        set type vlan
        set interface internal
        set vlanid 200
    next
    edit VLAN_200_ext
        set status down
        set type vlan
        set interface external
        set vlanid 200
end

```

### Add the security policies

Security policies allow packets to travel between the VLAN\_100\_int interface and the VLAN\_100\_ext interface. Two policies are required; one for each direction of traffic. The same is required between the VLAN\_200\_int interface and the VLAN\_200\_ext interface, for a total of four required security policies.

#### To add the security policies - web-based manager

1. Go to **Policy & Objects > Policy > IPv4** or **Policy & Objects > Policy > IPv6** and select **Create New**.
2. Enter the following information and select **OK**:

<b>Incoming Interface</b>	VLAN_100_int
<b>Source Address</b>	all
<b>Outgoing Interface</b>	VLAN_100_ext
<b>Destination Address</b>	all
<b>Schedule</b>	Always
<b>Service</b>	ALL
<b>Action</b>	ACCEPT

3. Select **Create New**.
4. Enter the following information and select **OK**:

<b>Incoming Interface</b>	VLAN_100_ext
<b>Source Address</b>	all
<b>Outgoing Interface</b>	VLAN_100_int
<b>Destination Address</b>	all
<b>Schedule</b>	Always

<b>Service</b>	ALL
<b>Action</b>	ACCEPT

- Go to **Policy & Objects > Policy > IPv4** or **Policy & Objects > Policy > IPv6** and select **Create New**.
- Enter the following information and select **OK**:

<b>Incoming Interface</b>	VLAN_200_int
<b>Source Address</b>	all
<b>Outgoing Interface</b>	VLAN_200_ext
<b>Destination Address</b>	all
<b>Schedule</b>	Always
<b>Service</b>	ALL
<b>Action</b>	ACCEPT
<b>Enable NAT</b>	Enable

- Select **Create New**.
- Enter the following information and select **OK**:

<b>Incoming Interface</b>	VLAN_200_ext
<b>Source Address</b>	all
<b>Outgoing Interface</b>	VLAN_200_int
<b>Destination Address</b>	all
<b>Schedule</b>	Always
<b>Service</b>	ALL
<b>Action</b>	ACCEPT

### To add the security policies - CLI

```
config firewall policy or config firewall policy6
edit 1
set srcintf VLAN_100_int
set srcaddr all
set dstintf VLAN_100_ext
set dstaddr all
set action accept
set schedule always
set service ALL
next
edit 2
set srcintf VLAN_100_ext
set srcaddr all
```

```

        set dstintf VLAN_100_int
        set dstaddr all
        set action accept
        set schedule always
        set service ALL
    next
    edit 3
        set srcintf VLAN_200_int
        set srcaddr all
        set dstintf VLAN_200_ext
        set dstaddr all
        set action accept
        set schedule always
        set service ALL
    next
    edit 4
        set srcintf VLAN_200_ext
        set srcaddr all
        set dstintf VLAN_200_int
        set dstaddr all
        set action accept
        set schedule always
        set service ALL
    end

```

## Configure the Cisco switch and router

This example includes configuration for the Cisco Catalyst 2900 ethernet switch, and for the Cisco Multiservice 2620 ethernet router. If you have access to a different VLAN enabled switch or VLAN router you can use them instead, however their configuration is not included in this document.

### Configure the Cisco switch

On the VLAN switch, you need to define VLAN\_100 and VLAN\_200 in the VLAN database and then add a configuration file to define the VLAN subinterfaces and the 802.1Q trunk interface.

Add this file to the Cisco switch:

```

interface FastEthernet0/3
switchport access vlan 100
!
interface FastEthernet0/9
switchport access vlan 200
!
interface FastEthernet0/24
switchport trunk encapsulation dot1q
switchport mode trunk
!

```

The switch has the following configuration:

<b>Port 0/3</b>	VLAN ID 100
<b>Port 0/9</b>	VLAN ID 200

<b>Port 0/24</b>	802.1Q trunk
------------------	--------------

## Configure the Cisco router

You need to add a configuration file to the Cisco Multiservice 2620 ethernet router. The file defines the VLAN subinterfaces and the 802.1Q trunk interface on the router. The 802.1Q trunk is the physical interface on the router.

The IP address for each VLAN on the router is the gateway for that VLAN. For example, all devices on the internal VLAN\_100 network will have 10.100.0.1 as their gateway.

Add this file to the Cisco router:

```
!
interface FastEthernet0/0
!
interface FastEthernet0/0.1
encapsulation dot1Q 100
ip address 10.100.0.1 255.255.255.0
!
interface FastEthernet0/0.2
encapsulation dot1Q 200
ip address 10.200.0.1 255.255.255.0
!
```

The router has the following configuration:

<b>Port 0/0.1</b>	VLAN ID 100
<b>Port 0/0.2</b>	VLAN ID 200
<b>Port 0/0</b>	802.1Q trunk

## Test the configuration

Use diagnostic network commands such as traceroute (`tracert`) and ping to test traffic routed through the network.

### Testing traffic from VLAN\_100 to VLAN\_200

In this example, a route is traced between the two internal networks. The route target is a host on VLAN\_200. The Windows traceroute command `tracert` is used.

From VLAN\_100, access a Windows command prompt and enter this command:

```
C:\>tracert 10.1.2.2
Tracing route to 10.1.2.2 over a maximum of 30 hops:
 1 <10 ms <10 ms <10 ms 10.1.1.1
 2 <10 ms <10 ms <10 ms 10.1.2.2
Trace complete.
```

## Troubleshooting VLAN issues

Several problems can occur with your VLANs. Since VLANs are interfaces with IP addresses, they behave as interfaces and can have similar problems that you can diagnose with tools such as ping, traceroute, packet sniffing, and diag debug.

### Asymmetric routing

You might discover unexpectedly that hosts on some networks are unable to reach certain other networks. This occurs when request and response packets follow different paths. If the FortiGate unit recognizes the response packets, but not the requests, it blocks the packets as invalid. Also, if the FortiGate unit recognizes the same packets repeated on multiple interfaces, it blocks the session as a potential attack.

This is asymmetric routing. By default, the FortiGate unit blocks packets or drops the session when this happens. You can configure the FortiGate unit to permit asymmetric routing by using the following CLI commands:

```
config system settings
    set asymroute enable
end
```

If VDOMs are enabled, this command is per VDOM. You must set it for each VDOM that has the problem as following:

```
config vdom
    edit <vdom_name>
        config system settings
            set asymroute enable
        end
    end
```

If this solves your blocked traffic issue, you know that asymmetric routing is the cause. But allowing asymmetric routing is not the best solution, because it reduces the security of your network.

For a long-term solution, it is better to change your routing configuration or change how your FortiGate unit connects to your network.



If you enable asymmetric routing, antivirus and intrusion prevention systems will not be effective. Your FortiGate unit will be unaware of connections and treat each packet individually. It will become a stateless firewall.

### Layer-2 and Arp traffic

By default, FortiGate units do not pass layer-2 traffic. If there are layer-2 protocols such as IPX, PPTP or L2TP in use on your network, you need to configure your FortiGate unit interfaces to pass these protocols without blocking. Another type of layer-2 traffic is ARP traffic.

You can allow these layer-2 protocols using the CLI command:

```
config system interface
    edit <name_str>
```

```
set l2forward enable
end
```

where `<name_str>` is the name of an interface.

If VDOMs are enabled, this command is per VDOM. You must set it for each VDOM that has the problem as following:

```
config vdom
edit <vdom_name>
config system interface
edit <name_str>
set l2forward enable
end
end
```

If you enable layer-2 traffic, you may experience a problem if packets are allowed to repeatedly loop through the network. This repeated looping, very similar to a broadcast storm, occurs when you have more than one layer-2 path to a destination. Traffic may overflow and bring your network to a halt. You can break the loop by enabling Spanning Tree Protocol (STP) on your network's switches and routers. For more information, see "STP forwarding".

## ARP traffic

Address Resolution Protocol (ARP) packets are vital to communication on a network, and ARP support is enabled on FortiGate unit interfaces by default. Normally you want ARP packets to pass through the FortiGate unit, especially if it is sitting between a client and a server or between a client and a router.

ARP traffic can cause problems, especially in transparent mode where ARP packets arriving on one interface are sent to all other interfaces including VLAN subinterfaces. Some layer-2 switches become unstable when they detect the same MAC address originating on more than one switch interface or from more than one VLAN. This instability can occur if the layer-2 switch does not maintain separate MAC address tables for each VLAN. Unstable switches may reset and cause network traffic to slow down considerably.

The default ARP timeout value is 5 minutes (300 seconds). So usually ARP entries are removed after 5 minutes. However, some conditions can cause arp entries to remain on the list for a longer time. This is not a configurable value. Enter the `get system arp` CLI command to view the ARP list.

## Multiple VDOMs solution

By default, physical interfaces are in the root domain. If you do not configure any of your VLANs in the root VDOM, it will not matter how many interfaces are in the root VDOM.

The multiple VDOMs solution is to configure multiple VDOMs on the FortiGate unit, one for each VLAN. In this solution, you configure one inbound and one outbound VLAN interface in each VDOM. ARP packets are not forwarded between VDOMs. This configuration limits the VLANs in a VDOM and correspondingly reduces the administration needed per VDOM.

As a result of this configuration, the switches do not receive multiple ARP packets with duplicate MACs. Instead, the switches receive ARP packets with different VLAN IDs and different MACs. Your switches are stable.

However, you should **not** use the multiple VDOMs solution under any of the following conditions:

- You have more VLANs than licensed VDOMs
- You do not have enough physical interfaces

Instead, use one of two possible solutions, depending on which operation mode you are using:



- In NAT mode, you can use the `vlan forward` CLI command.
- In transparent mode, you can use the `forward-domain` CLI command. But you still need to be careful in some rare configurations.

### Vlanforward solution

If you are using NAT mode, the solution is to use the `vlanforward` CLI command for the interface in question. By default, this command is enabled and will forward VLAN traffic to all VLANs on this interface. When disabled, each VLAN on this physical interface can send traffic only to the same VLAN. There is no cross-talk between VLANs, and ARP packets are forced to take one path along the network which prevents the multiple paths problem.

In the following example, `vlanforward` is disabled on port1. All VLANs configured on port1 will be separate and will not forward any traffic to each other.

```
config system interface
  edit port1
    set vlanforward disable
  end
```

### Forward-domain solution

If you are using transparent mode, the solution is to use the `forward-domain` CLI command. This command tags VLAN traffic as belonging to a particular collision group, and only VLANs tagged as part of that collision group receive that traffic. It is like an additional set of VLANs. By default, all interfaces and VLANs are part of forward-domain collision group 0. The many benefits of this solution include reduced administration, the need for fewer physical interfaces, and the availability of more flexible network solutions.

In the following example, forward-domain collision group 340 includes VLAN 340 traffic on port1 and untagged traffic on port 2. Forward-domain collision group 341 includes VLAN 341 traffic on port 1 and untagged traffic on port 3. All other interfaces are part of forward-domain collision group 0 by default. This configuration separates VLANs 340 and 341 from each other on port 1, and prevents the ARP packet problems from before.

Use these CLI commands:

```
config system interface
  edit port1
  next
  edit port2
    set forward_domain 340
  next
  edit port3
    set forward_domain 341
  next
  edit port1-340
    set forward_domain 340
    set interface port1
    set vlanid 340
  next
  edit port1-341
    set forward_domain 341
    set interface port1
    set vlanid 341
  end
```

You may experience connection issues with layer-2 traffic, such as ping, if your network configuration has:

- Packets going through the FortiGate unit in transparent mode more than once
- More than one forwarding domain (such as incoming on one forwarding domain and outgoing on another)
- IPS and AV enabled.

Now IPS and AV is applied the first time packets go through the FortiGate unit, but not on subsequent passes. Only applying IPS and AV to this first pass fixes the network layer-2 related connection issues.

## NetBIOS

Computers running Microsoft Windows operating systems that are connected through a network rely on a WINS server to resolve host names to IP addresses. The hosts communicate with the WINS server by using the NetBIOS protocol.

To support this type of network, you need to enable the forwarding of NetBIOS requests to a WINS server. The following example will forward NetBIOS requests on the internal interface for the WINS server located at an IP address of 192.168.111.222.

```
config system interface
  edit internal
    set netbios_forward enable
    set wins-ip 192.168.111.222
  end
```

These commands apply only in NAT mode. If VDOMs are enabled, these commands are per VDOM. You must set them for each VDOM that has the problem.

## STP forwarding

The FortiGate unit does not participate in the Spanning Tree Protocol (STP). STP is an IEEE 802.1 protocol that ensures there are no layer-2 loops on the network. Loops are created when there is more than one route for traffic to take and that traffic is broadcast back to the original switch. This loop floods the network with traffic, reducing available bandwidth to nothing.

If you use your FortiGate unit in a network topology that relies on STP for network loop protection, you need to make changes to your FortiGate configuration. Otherwise, STP recognizes your FortiGate unit as a blocked link and forwards the data to another path. By default, your FortiGate unit blocks STP as well as other non-IP protocol traffic.

Using the CLI, you can enable forwarding of STP and other layer-2 protocols through the interface. In this example, layer-2 forwarding is enabled on the external interface:

```
config system interface
  edit external
    set l2forward enable
    set stpforward enable
  end
```

By substituting different commands for `stpforward enable`, you can also allow layer-2 protocols such as IPX, PPTP or L2TP to be used on the network.

## Too many VLAN interfaces

Any virtual domain can have a maximum of 255 interfaces in transparent mode. This includes VLANs, other virtual interfaces, and physical interfaces. NAT mode supports from 255 to 8192 depending on the FortiGate model. This total number of interfaces includes VLANs, other virtual interfaces, and physical interfaces.

Your FortiGate unit may allow you to configure more interfaces than this. However, if you configure more than 255 interfaces, your system will become unstable and, over time, will not work properly. As all interfaces are used, they will overflow the routing table that stores the interface information, and connections will fail. When you try to add more interfaces, an error message will state that the maximum limit has already been reached.

If you see this error message, chances are you already have too many VLANs on your system and your routing has become unstable. To verify, delete a VLAN and try to add it back. If you have too many, you will not be able to add it back on to the system. In this case, you will need to remove enough interfaces (including VLANs) so that the total number of interfaces drops to 255 or less. After doing this, you should also reboot your FortiGate unit to clean up its memory and buffers, or you will continue to experience unstable behavior.

To configure more than 255 interfaces on your FortiGate unit in transparent mode, you have to configure multiple VDOMs, each with many VLANs. However, if you want to create more than the default 10 VDOMs (or a maximum of 2550 interfaces), you must buy a license for additional VDOMs. Only FortiGate models 3000 and higher support more than 10 VDOMs.

With these extra licenses, you can configure up to 500 VDOMs, with each VDOM containing up to 255 VLANs in transparent mode. This is a theoretical maximum of over 127 500 interfaces. However, system resources will quickly get used up before reaching that theoretical maximum. To achieve the maximum number of VDOMs, you need to have top-end hardware with the most resources possible.

In NAT mode, if you have a top-end model, the maximum interfaces per VDOM can be as high as 8192, enough for all the VLANs in your configuration.



Your FortiGate unit has limited resources, such as CPU load and memory, that are divided between all configured VDOMs. When running 250 or more VDOMs, you may need to monitor the system resources to ensure there is enough to support the configured traffic processing.

---

# PPTP and L2TP

A virtual private network (VPN) is a way to use a public network, such as the Internet, as a vehicle to provide remote offices or individual users with secure access to private networks. FortiOS supports the Point-to-Point Tunneling Protocol (PPTP), which enables interoperability between FortiGate units and Windows or Linux PPTP clients. Because FortiGate units support industry standard PPTP VPN technologies, you can configure a PPTP VPN between a FortiGate unit and most third-party PPTP VPN peers.

This section describes how to configure PPTP and L2TP VPNs as well as PPTP passthrough.

This section includes the topics:

- [How PPTP VPNs work](#)
- [FortiGate unit as a PPTP server](#)
- [Configuring the FortiGate unit for PPTP VPN](#)
- [Configuring the FortiGate unit for PPTP pass through](#)
- [Testing PPTP VPN connections](#)
- [Logging VPN events](#)
- [Configuring L2TP VPNs](#)
- [L2TP configuration overview](#)

## How PPTP VPNs work

The Point-to-Point Tunneling Protocol enables you to create a VPN between a remote client and your internal network. Because it is a Microsoft Windows standard, PPTP does not require third-party software on the client computer. As long as the ISP supports PPTP on its servers, you can create a secure connection by making relatively simple configuration changes to the client computer and the FortiGate unit.

PPTP uses Point-to-Point protocol (PPP) authentication protocols so that standard PPP software can operate on tunneled PPP links. PPTP packages data in PPP packets and then encapsulates the PPP packets within IP packets for transmission through a VPN tunnel.

When the FortiGate unit acts as a PPTP server, a PPTP session and tunnel is created as soon as the PPTP client connects to the FortiGate unit. More than one PPTP session can be supported on the same tunnel. FortiGate units support PAP, CHAP, and plain text authentication. PPTP clients are authenticated as members of a user group.

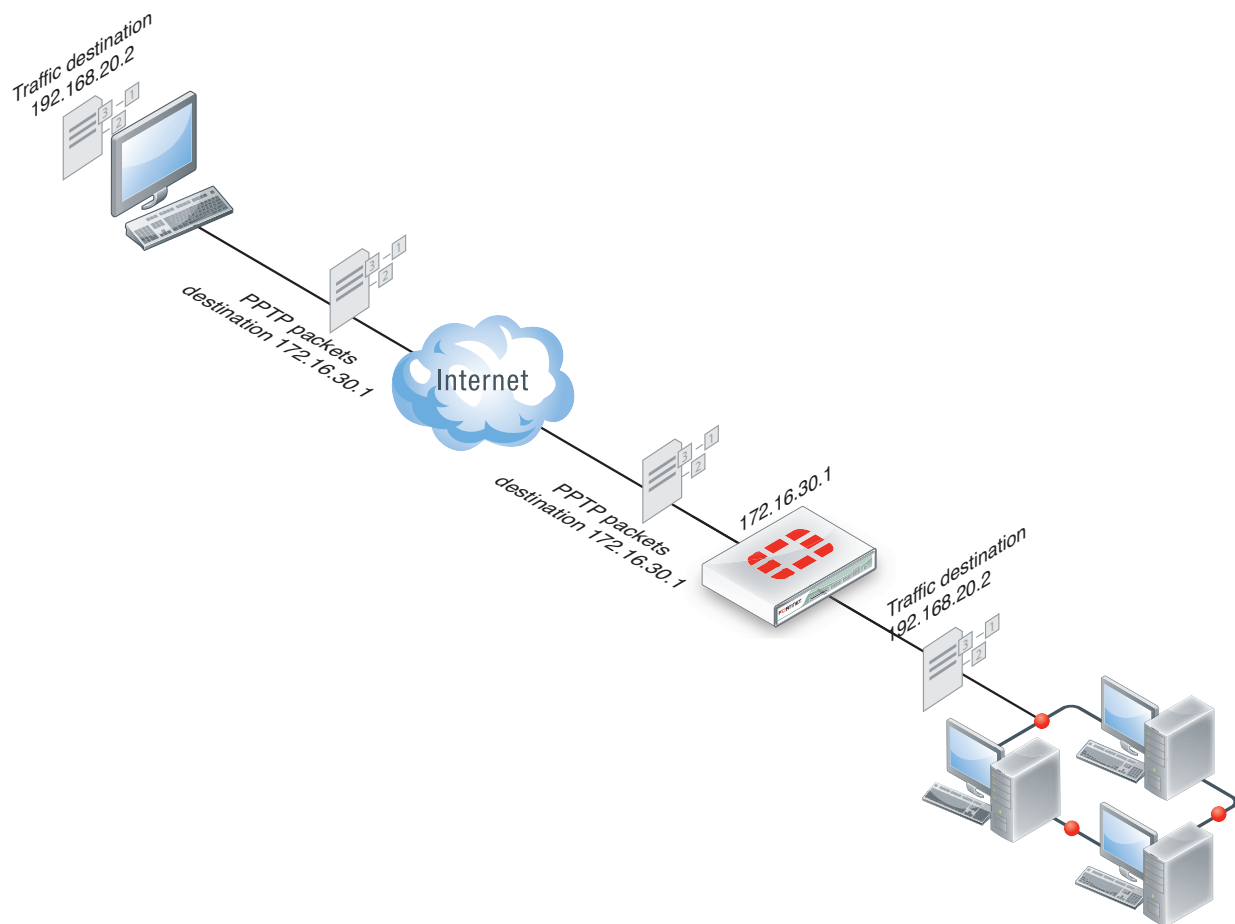
Traffic from one PPTP peer is encrypted using PPP before it is encapsulated using Generic Routing Encapsulation (GRE) and routed to the other PPTP peer through an ISP network. PPP packets from the remote client are addressed to a computer on the private network behind the FortiGate unit. PPTP packets from the remote client are addressed to the public interface of the FortiGate unit. See the figure below.



PPTP control channel messages are not authenticated, and their integrity is not protected. Furthermore, encapsulated PPP packets are not cryptographically protected and may be read or modified unless appropriate encryption software such as Secure Shell (SSH) or Secure File Transfer Protocol (SFTP) is used to transfer data after the tunnel has been established.

As an alternative, you can use encryption software such as Microsoft Point-to-Point Encryption (MPPE) to secure the channel. MPPE is built into Microsoft Windows clients and can be installed on Linux clients. FortiGate units support MPPE.

### Packet encapsulation



Shown above, traffic from the remote client is addressed to a computer on the network behind the FortiGate unit. When the PPTP tunnel is established, packets from the remote client are encapsulated and addressed to the FortiGate unit. The FortiGate unit forwards disassembled packets to the computer on the internal network.

When the remote PPTP client connects, the FortiGate unit assigns an IP address from a reserved range of IP addresses to the client PPTP interface. The PPTP client uses the assigned IP address as its source address for the duration of the connection.

When the FortiGate unit receives a PPTP packet, the unit disassembles the PPTP packet and forwards the packet to the correct computer on the internal network. The security policy and protection profiles on the FortiGate unit ensure that inbound traffic is screened and processed securely.

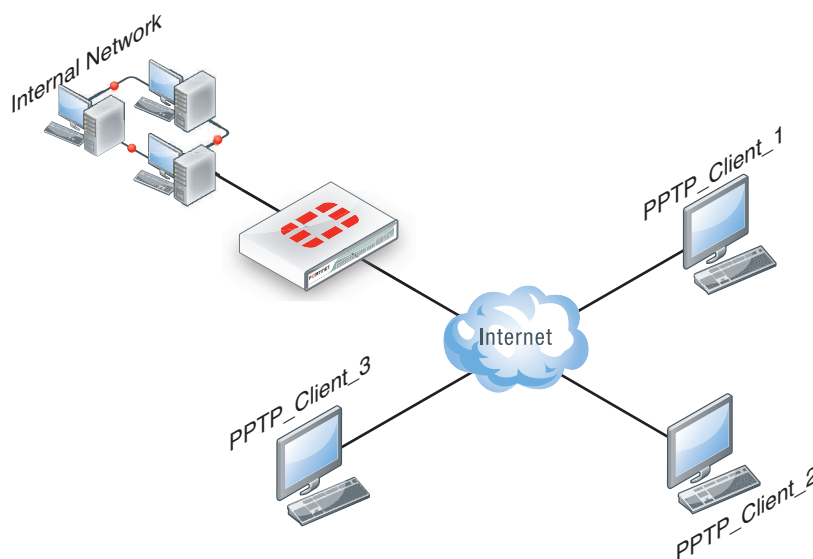


PPTP clients must be authenticated before a tunnel is established. The authentication process relies on FortiGate user group definitions, which can optionally use established authentication mechanisms such as RADIUS or LDAP to authenticate PPTP clients. All PPTP clients are challenged when a connection attempt is made.

## FortiGate unit as a PPTP server

In the most common Internet scenario, the PPTP client connects to an ISP that offers PPP connections with dynamically-assigned IP addresses. The ISP forwards PPTP packets to the Internet, where they are routed to the FortiGate unit.

### FortiGate unit as a PPTP server



If the FortiGate unit will act as a PPTP server, there are a number of steps to complete:

- Configure user authentication for PPTP clients.
- Enable PPTP.
- Specify the range of addresses that are assigned to PPTP clients when connecting
- Configure the security policy.

## Configuring user authentication for PPTP clients

To enable authentication for PPTP clients, you must create user accounts and a user group to identify the PPTP clients that need access to the network behind the FortiGate unit. Within the user group, you must add a user for each PPTP client.

You can choose to use a plain text password for authentication or forward authentication requests to an external RADIUS, LDAP, or TACACS+ server. If password protection will be provided through a RADIUS, LDAP, or TACACS+ server, you must configure the FortiGate unit to forward authentication requests to the authentication server.

This example creates a basic user/password combination.

## Configuring a user account

### To add a local user - web-based manager

1. Go to **User & Device > User > User Definition** and select **Create New**.
2. Select **Local User**
3. Enter a **User Name**.
4. Enter a **Password** for the user. The password should be at least six characters.
5. Select **OK**.

### To add a local user - CLI

```
config user local
  edit <username>
    set type password
    set passwd <password>
  end
```

## Configuring a user group

To ease configuration, create user groups that contain users in similar categories or departments.

### To create a user group - web-based manager

1. Go to **User & Device > User > User Group** and select **Create New**.
2. Enter a **Name** for the group.
3. Select the **Type** of **Firewall**.
4. From the **Available Users** list, select the required users and select the right-facing arrow to add them to the **Members** list.
5. Select **OK**.

### To create a user group - CLI

```
config user group
  edit <group_name>
    set group-type firewall
    set member <user_names>
  end
```

## Enabling PPTP and specifying the PPTP IP address range

The PPTP address range specifies the range of addresses reserved for remote PPTP clients. When a PPTP client connects to the FortiGate unit, the client is assigned an IP address from this range. Afterward, the FortiGate unit uses the assigned address to communicate with the PPTP client.

The address range that you reserve can be associated with private or routable IP addresses. If you specify a private address range that matches a network behind the FortiGate unit, the assigned address will make the PPTP client appear to be part of the internal network.

PPTP requires two IP addresses, one for each end of the tunnel. The PPTP address range is the range of addresses reserved for remote PPTP clients. When the remote PPTP client establishes a connection, the FortiGate unit assigns an IP address from the reserved range of IP addresses to the client PPTP interface or retrieves the assigned IP address from the PPTP user group. If you use the PPTP user group, you must also define the FortiGate end of the tunnel by entering the IP address of the unit in **Local IP** (web-based manager) **or** `local-ip` (CLI). The PPTP client uses the assigned IP address as its source address for the duration of the connection.

PPTP configuration is only available through the CLI. In the example below, PPTP is enabled with the use of an IP range of 192.168.1.1 to 192.168.1.10 for addressing and the user group is `hr_staff`.



The start and end IPs in the PPTP address range must be in the same 24-bit subnet, for example, 192.168.1.1 - 192.168.1.254.

```
config vpn pptp
    set status enable
    set ip-mode range
    set eip 192.168.1.10
    set sip 192.168.1.1
    set usrgrp hr_staff
end
```

In this example, PPTP is enabled with the use of a user group for addressing, where the IP address of the PPTP server is 192.168.1.2 and the user group is `hr_admin`.

```
config vpn pptp
    set status enable
    set ip-mode range
    set local-ip 192.168.2.1
    set usrgrp hr_admin
end
```

## Adding the security policy

The security policy specifies the source and destination addresses that can generate traffic inside the PPTP tunnel and defines the scope of services permitted through the tunnel. If a selection of services are required, define a service group.

### To configure the firewall for the PPTP tunnel - web-based manager

1. Go to **Policy & Objects > Policy > IPv4** or **Policy & Objects > Policy > IPv6** and select **Create New**.
2. Complete the following and select **OK**:

<b>Incoming Interface</b>	The FortiGate interface connected to the Internet.
<b>Source Address</b>	Select the name that corresponds to the range of addresses that you reserved for PPTP clients.
<b>Outgoing Interface</b>	The FortiGate interface connected to the internal network.



<b>Destination Address</b>	Select the name that corresponds to the IP addresses behind the FortiGate unit.
<b>Schedule</b>	always
<b>Service</b>	ALL
<b>Action</b>	ACCEPT

### To configure the firewall for the PPTP tunnel - CLI

```
config firewall policy or config firewall policy6
  edit 1
    set srcintf <interface to internet>
    set dstintf <interface to internal network>
    set srcaddr <reserved_range>
    set dstaddr <internal_addresses>
    set action accept
    set schedule always
    set service ALL
  end
```

## Configuring the FortiGate unit for PPTP VPN

To arrange for PPTP packets to pass through the FortiGate unit to an external PPTP server, perform the following tasks in the order given:

- Configure user authentication for PPTP clients.
- Enable PPTP on the FortiGate unit and specify the range of addresses that can be assigned to PPTP clients when they connect.
- Configure PPTP pass through on the FortiGate unit.

## Configuring the FortiGate unit for PPTP pass through

To forward PPTP packets to a PPTP server on the network behind the FortiGate unit, you need to perform the following configuration tasks on the FortiGate unit:

- Define a virtual IP address that points to the PPTP server.
- Create a security policy that allows incoming PPTP packets to pass through to the PPTP server.



The address range is the external (public) ip address range which requires access to the internal PPTP server through the FortiGate virtual port-forwarding firewall.

IP addresses used in this document are fictional and follow the technical documentation guidelines specific to Fortinet. Real external IP addresses are not used.

## Configuring a virtual IP address

The virtual IP address will be the address of the PPTP server host.

### To define a virtual IP for PPTP pass through - web-based manager

1. Go to **Policy & Objects > Objects > Virtual IPs**.
2. Select **Create New**.
3. Choose the **VIP Type**.
4. Enter the name of the VIP, for example, `PPTP_Server`.
5. Select the **External Interface** where the packets will be received for the PPTP server.
6. Enter the **External IP Address** for the VIP.
7. Select **Port Forwarding**.
8. Set the **Protocol to TCP**.
9. Enter the **External Service Port** of 1723, the default for PPTP.
10. Enter the **Map to Port** to 1723.
11. Select **OK**.

### To define a virtual IP for PPTP pass through - web-based manager

```
config firewall vip or config firewall vip6
  edit PPTP_Server
    set extintf <interface>
    set extip <ip_address>
    set portforward enable
    set protocol tcp
    set extport 1723
    set mappedport 1723
    set mappedip <destination IP address range>
  end
```

You can also use `config firewall vip46` to define a virtual IP from an IPv4 address to an IPv6 address or `config firewall vip64` to define a virtual IP from an IPv6 address to an IPv4 address.

## Configuring a port-forwarding security policy

To create a port-forwarding security policy for PPTP pass through you must first create an address range reserved for the PPTP clients.

### To create an address range - web-based manager

1. Go to **Policy & Objects > Objects > Addresses** and select **Create New**.
2. Select a **Category**.
3. Enter a **Name** for the range, for example, `External_PPTP`.
4. Select a **Type** of **Subnet/IP Range**.
5. Enter the IP address range.
6. Select the **Interface** to the Internet.
7. Select **OK**.

**To create an address range - CLI**

```
config firewall address OR config firewall address6
edit External_PPTP
set type iprange
set start-ip <ip_address>
set end-ip <ip_address>
set associated-interface <internet_interface>
end
```

With the address set, you can add the security policy.

**To add the security policy - web-based manager**

1. Go to **Policy & Objects > Policy > IPv4** or **Policy & Objects > Policy > IPv6** and select **Create New**.
2. Complete the following and select **OK**:

<b>Incoming Interface</b>	The FortiGate interface connected to the Internet.
<b>Source Address</b>	Select the address range created in the previous step.
<b>Outgoing Interface</b>	The FortiGate interface connected to the PPTP server.
<b>Destination Address</b>	Select the VIP address created in the previous steps.
<b>Schedule</b>	always
<b>Service</b>	PPTP
<b>Action</b>	ACCEPT

**To add the security policy - CLI**

```
config firewall policy OR config firewall policy6
edit <policy_number>
set srcintf <interface to internet>
set dstintf <interface to PPTP server>
set srcaddr <address_range>
set dstaddr <PPTP_server_address>
set action accept
set schedule always
set service PPTP
end
```

## Testing PPTP VPN connections

To confirm that a PPTP VPN between a local network and a dialup client has been configured correctly, at the dialup client, issue a ping command to test the connection to the local network. The PPTP VPN tunnel initializes when the dialup client attempts to connect.

## Logging VPN events

PPTP VPN, activity is logged when enabling VPN logging. The FortiGate unit connection events and tunnel status (up/down) are logged.

### To log VPN events

1. Go to **Log & Report > Log Config > Log Settings**.
2. Enable the storage of log messages to one or more locations.
3. Select **VPN activity event**.
4. Select **Apply**.

### To view event logs

1. Go to **Log & Report > Event Log > VPN**.
2. If the option is available from the Log Type list, select the log file from disk or memory.

## Configuring L2TP VPNs

This section describes how to configure a FortiGate unit to establish a Layer Two Tunneling Protocol (L2TP) tunnel with a remote dialup client. The FortiGate implementation of L2TP enables a remote dialup client to establish an L2TP tunnel with the FortiGate unit directly.

According to RFC 2661, an Access Concentrator (LAC) can establish an L2TP tunnel with an L2TP Network Server (LNS). In a typical scenario, the LAC is managed by an ISP and located on the ISP premises; the LNS is the gateway to a private network. When a remote dialup client connects to the Internet through the ISP, the ISP uses a local database to establish the identity of the caller and determine whether the caller needs access to an LNS through an L2TP tunnel. If the services registered to the caller indicate that an L2TP connection to the LNS is required, the ISP LAC attempts to establish an L2TP tunnel with the LNS.

A FortiGate unit can be configured to act as an LNS. The FortiGate implementation of L2TP enables a remote dialup client to establish an L2TP tunnel with the FortiGate unit directly, bypassing any LAC managed by an ISP. The ISP must configure its network access server to forward L2TP traffic from the remote client to the FortiGate unit directly whenever the remote client requires an L2TP connection to the FortiGate unit.

When the FortiGate unit acts as an LNS, an L2TP session and tunnel is created as soon as the remote client connects to the FortiGate unit. The FortiGate unit assigns an IP address to the client from a reserved range of IP addresses. The remote client uses the assigned IP address as its source address for the duration of the connection.

More than one L2TP session can be supported on the same tunnel. FortiGate units can be configured to authenticate remote clients using a plain text user name and password, or authentication can be forwarded to an external RADIUS or LDAP server. L2TP clients are authenticated as members of a user group.

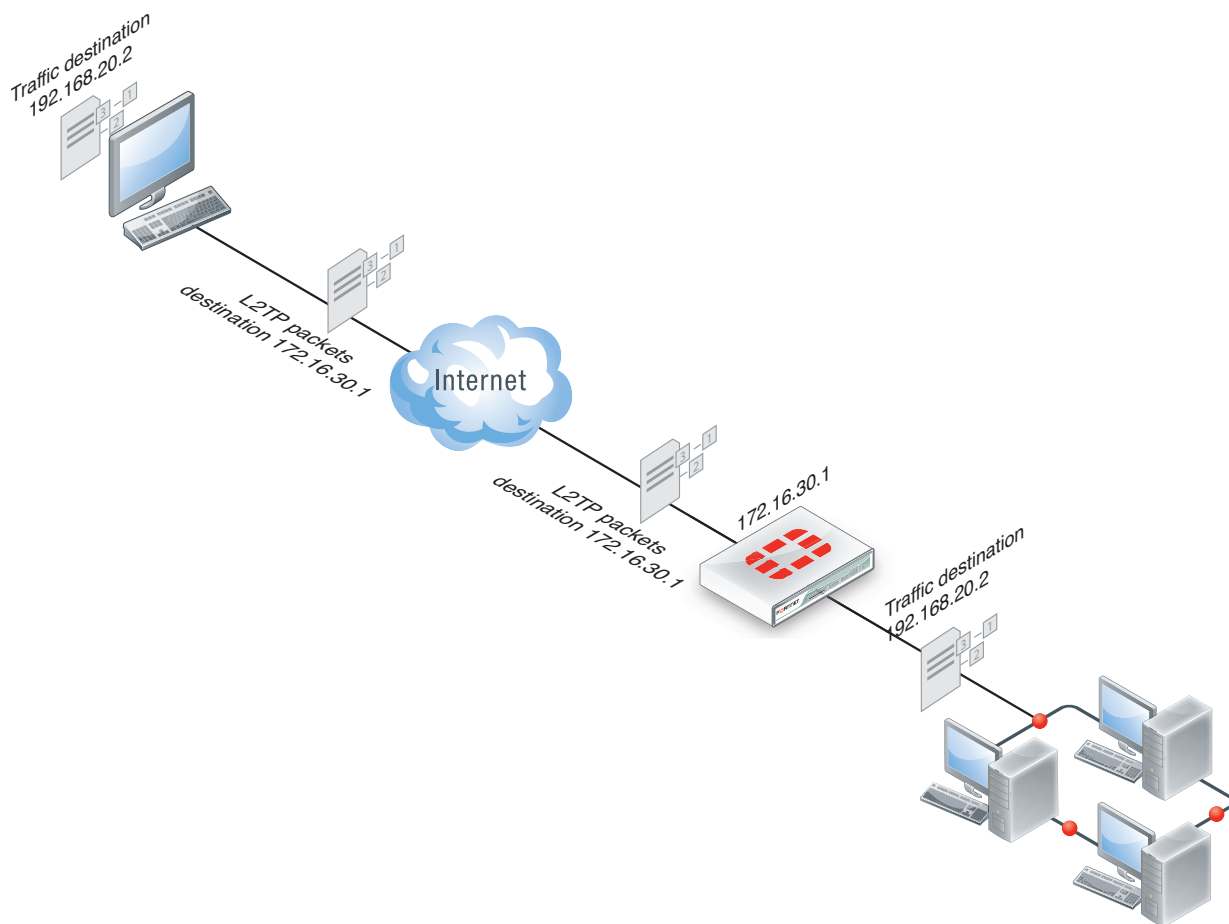


FortiGate units support L2TP with Microsoft Point-to-Point Encryption (MPPE) encryption only. Later implementations of Microsoft L2TP for Windows use IPsec and require certificates for authentication and encryption. If you want to use Microsoft L2TP with IPsec to connect to a FortiGate unit, the IPsec and certificate elements must be disabled on the remote client.

Traffic from the remote client must be encrypted using MPPE before it is encapsulated and routed to the FortiGate unit. Packets originating at the remote client are addressed to a computer on the private network behind the FortiGate unit. Encapsulated packets are addressed to the public interface of the FortiGate unit. See the figure below.

When the FortiGate unit receives an L2TP packet, the unit disassembles the packet and forwards the packet to the correct computer on the internal network. The security policy and protection profiles on the FortiGate unit ensure that inbound traffic is screened and processed securely.

### L2TP encapsulation

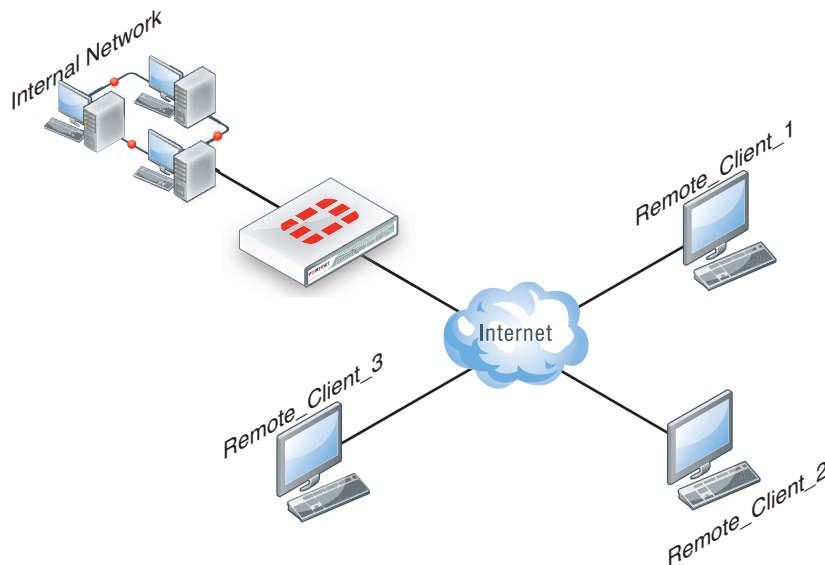


FortiGate units cannot deliver non-IP traffic such as Frame Relay or ATM frames encapsulated in L2TP packets — FortiGate units support the IPv4 and IPv6 addressing schemes only

## Network topology

The remote client connects to an ISP that determines whether the client requires an L2TP connection to the FortiGate unit. If an L2TP connection is required, the connection request is forwarded to the FortiGate unit directly.

### Example L2TP configuration



## L2TP infrastructure requirements

- The FortiGate unit must be operating in NAT mode and have a static public IP address.
- The ISP must configure its network access server to forward L2TP traffic from remote clients to the FortiGate unit directly.
- The remote client must not generate non-IP traffic (Frame Relay or ATM frames).
- The remote client includes L2TP support with MPPE encryption. If the remote client includes Microsoft L2TP with IPsec, the IPsec and certificate components must be disabled.

## L2TP configuration overview

To configure a FortiGate unit to act as an LNS, you perform the following tasks:

- Create an L2TP user group containing one user for each remote client.
- Enable L2TP on the FortiGate unit and specify the range of addresses that can be assigned to remote clients when they connect.
- Define firewall source and destination addresses to indicate where packets transported through the L2TP tunnel will originate and be delivered.
- Create the security policy and define the scope of permitted services between the source and destination

addresses.

- Configure the remote clients.

## Authenticating L2TP clients

L2TP clients must be authenticated before a tunnel is established. The authentication process relies on FortiGate user group definitions, which can optionally use established authentication mechanisms such as RADIUS or LDAP to authenticate L2TP clients. All L2TP clients are challenged when a connection attempt is made.

To enable authentication, you must create user accounts and a user group to identify the L2TP clients that need access to the network behind the FortiGate unit.

You can choose to use a plain text password for authentication or forward authentication requests to an external RADIUS or LDAP server. If password protection will be provided through a RADIUS or LDAP server, you must configure the FortiGate unit to forward authentication requests to the authentication server.

## Enabling L2TP and specifying an address range

The L2TP address range specifies the range of addresses reserved for remote clients. When a remote client connects to the FortiGate unit, the client is assigned an IP address from this range. Afterward, the FortiGate unit uses the assigned address to communicate with the remote client.

The address range that you reserve can be associated with private or routable IP addresses. If you specify a private address range that matches a network behind the FortiGate unit, the assigned address will make the remote client appear to be part of the internal network.

To enable L2TP and specify the L2TP address range, use the `config vpn l2tp` CLI command.

The following example shows how to enable L2TP and set the L2TP address range using a starting address of 192.168.10.80 and an ending address of 192.168.10.100 for an existing group of L2TP users named L2TP\_users:

```
config vpn l2tp
  set sip 192.168.10.80
  set eip 192.168.10.100
  set status enable
  set usrgroup L2TP_users
end
```

## Defining firewall source and destination addresses

Before you define the security policy, you must define the source and destination addresses of packets that are to be transported through the L2TP tunnel:

- For the source address, enter the range of addresses that you reserved for remote L2TP clients (for example 192.168.10.[80-100]).
- For the destination address, enter the IP addresses of the computers that the L2TP clients need to access on the private network behind the FortiGate unit (for example, 172.16.5.0/24 for a subnet, or 172.16.5.1 for a server or host, or 192.168.10.[10-15] for an IP address range).

### To define the firewall source address

1. Go to **Policy & Objects > Objects > Addresses** and select **Create New**.
2. Select a **Category**.

3. In the **Address Name** field, type a name that represents the range of addresses that you reserved for remote clients (for example, `Ext_L2TPrange`).
4. In **Type**, select **IP Range**.
5. In the **IP Range** field, type the corresponding IP address range.
6. In **Interface**, select the FortiGate interface that connects to the clients.
7. This is usually the interface that connects to the Internet.
8. Select **OK**.

#### To define the firewall destination address

1. Go to **Policy & Objects > Objects > Addresses** and select **Create New**.
2. In the **Address Name** field, type a name that represents a range of IP addresses on the network behind the FortiGate unit (for example, `Int_L2TPaccess`).
3. In **Type**, select **IP Range**.
4. In the **IP Range** field, type the corresponding IP address range.
5. In **Interface**, select the FortiGate interface that connects to the network behind the FortiGate unit.
6. Select **OK**.

## Adding the security policy

The security policy specifies the source and destination addresses that can generate traffic inside the L2TP tunnel and defines the scope of services permitted through the tunnel. If a selection of services are required, define a service group.

#### To define the traffic and services permitted inside the L2TP tunnel

1. Go to **Policy & Objects > Policy > IPv4** or **Policy & Objects > Policy > IPv6** and select **Create New**.
2. Enter these settings:

<b>Incoming Interface</b>	Select the FortiGate interface to the Internet.
<b>Source Address</b>	Select the name that corresponds to the address range that reserved for L2TP clients (for example, <code>Ext_L2TPrange</code> ).
<b>Outgoing Interface</b>	Select the FortiGate interface to the internal (private) network.
<b>Destination Address</b>	Select the name that corresponds to the IP addresses behind the FortiGate unit (for example, <code>Int_L2TPaccess</code> ).
<b>Service</b>	Select ALL, or if selected services are required instead, select the service group that you defined previously.
<b>Action</b>	ACCEPT

3. Select **OK**.



## Configuring a Linux client

This procedure outlines how to install L2TP client software and run an L2TP tunnel on a Linux computer. Obtain an L2TP client package that meets your requirements (for example, `rp-l2tp`). If needed to encrypt traffic, obtain L2TP client software that supports encryption using MPPE.

To establish an L2TP tunnel with a FortiGate unit that has been set up to accept L2TP connections, you can obtain and install the client software following these guidelines:

1. If encryption is required but MPPE support is not already present in the kernel, download and install an MPPE kernel module and reboot your computer.
2. Download and install the L2TP client package.
3. Configure an L2TP connection to run the L2TP program.
4. Configure routes to determine whether all or some of your network traffic will be sent through the tunnel. You must define a route to the remote network over the L2TP link and a host route to the FortiGate unit.
5. Run `l2tpd` to start the tunnel.

Follow the software supplier's documentation to complete the steps.

To configure the system, you need to know the public IP address of the FortiGate unit, and the user name and password that has been set up on the FortiGate unit to authenticate L2TP clients. Contact the FortiGate administrator if required to obtain this information.

## Monitoring L2TP sessions

You can display a list of all active sessions and view activity by port number. By default, port 1701 is used for L2TP VPN-related communications. If required, active sessions can be stopped from this view. Use the Top Sessions Dashboard Widget.

## Testing L2TP VPN connections

To confirm that a VPN between a local network and a dialup client has been configured correctly, at the dialup client, issue a ping command to test the connection to the local network. The VPN tunnel initializes when the dialup client attempts to connect.

## Logging L2TP VPN events

You can configure the FortiGate unit to log VPN events. For L2TP VPNs, connection events and tunnel status (up/down) are logged.

### To log VPN events - web-based manager

1. Go to **Log & Report > Log Config > Log Settings**.
2. Enable the storage of log messages to one or more locations.
3. Select **Enable**, and then select **VPN activity event**.
4. Select **Apply**.

### To log VPN events - CLI

```
config log memory setting
```

```
    set diskfull overwrite
    set status enable
end
config log eventfilter
    set vpn enable
end
```

# Session helpers

The FortiOS firewall can analyze most TCP/IP protocol traffic by comparing packet header information to security policies. This comparison determines whether to accept or deny the packet and the session that the packet belongs to.

Some protocols include information in the packet body (or payload) that must be analyzed to successfully process sessions for this protocol. For example, the SIP VoIP protocol uses TCP control packets with a standard destination port to set up SIP calls. But the packets that carry the actual conversation can use a variety of UDP protocols with a variety of source and destination port numbers. The information about the protocols and port numbers used for a SIP call is contained in the body of the SIP TCP control packets. To successfully process SIP VoIP calls, FortiOS must be able to extract information from the body of the SIP packet and use this information to allow the voice-carrying packets through the firewall.

FortiOS uses session helpers to analyze the data in the packet bodies of some protocols and adjust the firewall to allow those protocols to send packets through the firewall.

This section includes the topics:

- [Viewing the session helper configuration](#)
- [Changing the session helper configuration](#)
- [DCE-RPC session helper \(dcerpc\)](#)
- [DNS session helpers \(dns-tcp and dns-udp\)](#)
- [File transfer protocol \(FTP\) session helper \(ftp\)](#)
- [H.245 session helpers \(h245I and h245O\)](#)
- [H.323 and RAS session helpers \(h323 and ras\)](#)
- [Media Gateway Controller Protocol \(MGCP\) session helper \(mgcp\)](#)
- [ONC-RPC portmapper session helper \(pmap\)](#)
- [PPTP session helper for PPTP traffic \(pptp\)](#)
- [Remote shell session helper \(rsh\)](#)
- [Real-Time Streaming Protocol \(RTSP\) session helper \(rtsp\)](#)
- [Session Initiation Protocol \(SIP\) session helper \(sip\)](#)
- [Trivial File Transfer Protocol \(TFTP\) session helper \(tftp\)](#)
- [Oracle TNS listener session helper \(tns\)](#)

## Viewing the session helper configuration

You can view the session helpers enabled on your FortiGate unit in the CLI using the commands below. The following output shows the first two session helpers. The number of session helpers can vary to around 20.

```
show system session-helper
config system session-helper
edit 1
    set name pptp
    set port 1723
    set protocol 6
next
```

```
set name h323
set port 1720
set protocol 6
end
.
.
```

The configuration for each session helper includes the name of the session helper and the port and protocol number on which the session helper listens for sessions. Session helpers listed on protocol number 6 (TCP) or 17 (UDP). For a complete list of protocol numbers see [Assigned Internet Protocol Numbers](#).

For example, the output above shows that FortiOS listens for PPTP packets on TCP port 1723 and H.323 packets on port TCP port 1720.

If a session helper listens on more than one port or protocol the more than one entry for the session helper appears in the `config system session-helper` list. For example, the pmap session helper appears twice because it listens on TCP port 111 and UDP port 111. The rsh session helper appears twice because it listens on TCP ports 514 and 512.

## Changing the session helper configuration

Normally you will not need to change the configuration of the session helpers. However in some cases you may need to change the protocol or port the session helper listens on.

### Changing the protocol or port that a session helper listens on

Most session helpers are configured to listen for their sessions on the port and protocol that they typically use. If your FortiGate unit receives sessions that should be handled by a session helper on a non-standard port or protocol you can use the following procedure to change the port and protocol used by a session helper. The following example shows how to change the port that the pmap session helper listens on for Sun RPC portmapper TCP sessions. By default pmap listens on TCP port 111.

#### To change the port that the pmap session helper listens on to TCP port 112

1. Confirm that the TCP pmap session helper entry is 11 in the session-helper list:

```
show system session-helper 11
config system session-helper
edit 11
set name pmap
set port 111
set protocol 6
next
end
```

2. Enter the following command to change the TCP port to 112.

```
config system session-helper
edit 11
set port 112
end
```

3. The pmap session helper also listens on UDP port 111. Confirm that the UDP pmap session helper entry is 12 in the session-helper list:

```
show system session-helper 12
config system session-helper
edit 12
    set name pmap
    set port 111
    set protocol 17
end
```

4. Enter the following command to change the UDP port to 112.

```
config system session-helper
edit 12
    set port 112
end
```

Use the following command to set the h323 session helper to listen for ports on the UDP protocol.

### To change the protocol that the h323 session helper listens on

1. Confirm that the h323 session helper entry is 2 in the session-helper list:

```
show system session-helper 2
config system session-helper
edit 2
    set name h323
    set port 1720
    set protocol 6
next
end
```

2. Enter the following command to change the protocol to UDP.

```
config system session-helper
edit 2
    set protocol 17
end
end
```

If a session helper listens on more than one port or protocol, then multiple entries for the session helper must be added to the session helper list, one for each port and protocol combination. For example, the rtsp session helper listens on TCP ports 554, 7070, and 8554 so there are three rtsp entries in the session-helper list. If your FortiGate unit receives rtsp packets on a different TCP port (for example, 6677) you can use the following command to configure the rtsp session helper to listen on TCP port 6677.

### To configure a session helper to listen on a new port and protocol

```
config system session-helper
edit 0
    set name rtsp
    set port 6677
    set protocol 6
end
```

## Disabling a session helper

In some cases you may need to disable a session helper. Disabling a session helper just means removing it from the session-helper list so that the session helper is not listening on a port. You can completely disable a session

helper by deleting all of its entries from the session helper list. If there are multiple entries for a session helper on the list you can delete one of the entries to prevent the session helper from listening on that port.

### To disable the mgcp session helper from listening on UDP port 2427

1. Enter the following command to find the mgcp session helper entry that listens on UDP port 2427:

```
show system session-helper
.
.
.
edit 19
  set name mgcp
  set port 2427
  set protocol 17
next
.
.
.
```

2. Enter the following command to delete session-helper list entry number 19 to disable the mgcp session helper from listening on UDP port 2427:

```
config system session-helper
  delete 19
```

By default the mgcp session helper listens on UDP ports 2427 and 2727. The previous procedure shows how to disable the mgcp protocol from listening on port 2427. The following procedure completely disables the mgcp session helper by also disabling it from listening on UDP port 2727.

### To completely disable the mgcp session helper

1. Enter the following command to find the mgcp session helper entry that listens on UDP port 2727:

```
show system session-helper
.
.
.
edit 20
  set name mgcp
  set port 2727
  set protocol 17
next
.
.
.
```

2. Enter the following command to delete session-helper list entry number 20 to disable the mgcp session helper from listening on UDP port 2727:

```
config system session-helper
  delete 20
```

## DCE-RPC session helper (dcerpc)

Distributed Computing Environment Remote Procedure Call (DCE-RPC) provides a way for a program running on one host to call procedures in a program running on another host. DCE-RPC (also called MS RPC for Microsoft RPC) is similar to ONC-RPC. Because of the large number of RPC services, for example, MAPI, the transport address of an RPC service is dynamically negotiated based on the service program's universal unique identifier (UUID). The Endpoint Mapper (EPM) binding protocol in FortiOS maps the specific UUID to a transport address.

To accept DCE-RPC sessions you must add a security policy with service set to any or to the DEC-RPC pre-defined service (which listens on TCP and UDP ports 135). The dcerpc session helper also listens on TCP and UDP ports 135.

The session allows FortiOS to handle DCE-RPC dynamic transport address negotiation and to ensure UUID-based security policy enforcement. You can define a security policy to permit all RPC requests or to permit by specific UUID number.

In addition, because a TCP segment in a DCE-RPC stream might be fragmented, it might not include an intact RPC PDU. This fragmentation occurs in the RPC layer; so FortiOS does not support parsing fragmented packets.

## DNS session helpers (dns-tcp and dns-udp)

FortiOS includes two DNS session helpers, dns-tcp, a session helper for DNS over TCP, and dns-udp, a session helper for DNS over UDP.

To accept DNS sessions you must add a security policy with service set to any or to the DNS pre-defined service (which listens on TCP and UDP ports 53). The dns-udp session helper also listens on UDP port 53. By default the dns-tcp session helper is disabled. If needed you can use the following command to enable the dns-tcp session helper to listen for DNS sessions on TCP port 53:

```
config system session-helper
  edit 0
    set name dns-tcp
    set port 53
    set protocol 6
  end
```

## File transfer protocol (FTP) session helper (ftp)

The FTP session helper monitors PORT, PASV and 227 commands and NATs the IP addresses and port numbers in the body of the FTP packets and opens ports on the FortiGate unit as required.

To accept FTP sessions you must add a security policy with service set to any or to the FTP, FTP\_Put, and FTP\_GET pre-defined services (which all listen on TCP port 21).

## H.245 session helpers (h245I and h245O)

H.245 is a control channel protocol used for H.323 and other similar communication sessions. H.245 sessions transmit non-telephone signals. H.245 sessions carry information needed for multimedia communication, such as encryption, flow control jitter management and others.

FortiOS includes two H.245 sessions helpers, h245I which is for H.245 call in and h245O which is for H.245 call out sessions. There is no standard port for H.245. By default the H.245 sessions helpers are disabled. You can enable them as you would any other session helper. When you enable them, you should specify the port and protocol on which the FortiGate unit receives H.245 sessions.

## H.323 and RAS session helpers (h323 and ras)

The H.323 session helper supports secure H.323 voice over IP (VoIP) sessions between terminal endpoints such as IP phones and multimedia devices. In H.323 VoIP networks, gatekeeper devices manage call registration, admission, and call status for VoIP calls. The FortiOS h323 session helper supports gatekeepers installed on two different networks or on the same network.

To accept H.323 sessions you must add a security policy with service set to any or to the H323 pre-defined service (which listens on TCP port numbers 1720 and 1503 and on UDP port number 1719). The h323 session helper listens on TCP port 1720.

The ras session helper is used with the h323 session helper for H.323 Registration, Admission, and Status (RAS) services. The ras session helper listens on UDP port 1719.

### Alternate H.323 gatekeepers

The h323 session helper supports using H.323 alternate gatekeepers. All the H.323 end points must register with a gatekeeper through the Registration, Admission, and Status (RAS) protocol before they make calls. During the registration process, the primary gatekeeper sends Gatekeeper Confirm (GCF) and Registration Confirm (RCF) messages to the H.323 end points that contain the list of available alternate gatekeepers.

The alternate gatekeeper provides redundancy and scalability for the H.323 end points. If the primary gatekeeper fails the H.323 end points that have registered with that gatekeeper are automatically registered with the alternate gatekeeper. To use the H.323 alternate gatekeeper, you need to configure security policies that allow H.323 end points to reach the alternate gatekeeper.

## Media Gateway Controller Protocol (MGCP) session helper (mgcp)

The Media Gateway Control Protocol (MGCP) is a text-based application layer protocol used for VoIP call setup and control. MGCP uses a master-slave call control architecture in which the media gateway controller uses a call agent to maintain call control intelligence, while the media gateways perform the instructions of the call agent.

To accept MGCP sessions you must add a security policy with service set to any or to the MGCP pre-defined service (which listens on UDP port numbers 2427 and 2727). The h323 session helper also listens on UDP port numbers 2427 and 2727.



The MGCP session helper does the following:

- VoIP signalling payload inspection. The payload of the incoming VoIP signalling packet is inspected and malformed packets are blocked.
- Signaling packet body inspection. The payload of the incoming MGCP signaling packet is inspected according to RFC 3435. Malformed packets are blocked.
- Stateful processing of MGCP sessions. State machines are invoked to process the parsed information. Any out-of-state or out-of-transaction packet is identified and properly handled.
- MGCP Network Address Translation (NAT). Embedded IP addresses and ports in packet bodies is properly translated based on current routing information and network topology, and is replaced with the translated IP address and port number, if necessary.
- Manages pinholes for VoIP traffic. To keep the VoIP network secure, the IP address and port information used for media or signalling is identified by the session helper, and pinholes are dynamically created and closed during call setup.

## ONC-RPC portmapper session helper (pmap)

Open Network Computing Remote Procedure Call (ONC-RPC) is a widely deployed remote procedure call system. Also called Sun RPC, ONC-RPC allows a program running on one host to call a program running on another. The transport address of an ONC-RPC service is dynamically negotiated based on the service's program number and version number. Several binding protocols are defined for mapping the RPC program number and version number to a transport address.

To accept ONC-RPC sessions you must add a security policy with service set to any or to the ONC-RPC pre-defined service (which listens on TCP and UDP port number 111). The RPC portmapper session helper (called pmap) handles the dynamic transport address negotiation mechanisms of ONC-RPC.

## PPTP session helper for PPTP traffic (pptp)

The PPTP session help supports port address translation (PAT) for PPTP traffic. PPTP provides IP security at the Network Layer. PPTP consists of a control session and a data tunnel. The control session runs over TCP and helps in establishing and disconnecting the data tunnel. The data tunnel handles encapsulated Point-to-Point Protocol (PPP) packets carried over IP.

To accept PPTP sessions that pass through the FortiGate unit you must add a security policy with service set to any or to the PPTP pre-defined service (which listens on IP port 47 and TCP port 1723). The pptp session helper listens on TCP port 1723.

PPTP uses TCP port 1723 for control sessions and Generic Routing Encapsulation (GRE) (IP protocol 47) for tunneling the encapsulated PPP data. The GRE traffic carries no port number, making it difficult to distinguish between two clients with the same public IP address. PPTP uses the source IP address and the Call ID field in the GRE header to identify a tunnel. When multiple clients sharing the same IP address establish tunnels with the same PPTP server, they may get the same Call ID. The call ID value can be translated in both the control message and the data traffic, but only when the client is in a private network and the server is in a public network.

PPTP clients can either directly connect to the Internet or dial into a network access server to reach the Internet. A FortiGate unit that protects PPTP clients can translate the clients' private IP addresses to a pool of public IP addresses using NAT port translation (NAT-PT). Because the GRE traffic carries no port number for address

translation, the pptp session helper treats the Call ID field as a port number as a way of distinguishing multiple clients.

After the PPTP establishing a TCP connection with the PPTP server, the client sends a start control connection request message to establish a control connection. The server replies with a start control connection reply message. The client then sends a request to establish a call and sends an outgoing call request message. FortiOS assigns a Call ID (bytes 12-13 of the control message) that is unique to each PPTP tunnel. The server replies with an outgoing call reply message that carries its own Call ID in bytes 12-13 and the client's call ID in bytes 14-15. The pptp session helper parses the control connection messages for the Call ID to identify the call to which a specific PPP packet belongs. The session helper also identifies an outgoing call request message using the control message type field (bytes 8-9) with the value 7. When the session helper receives this message, it parses the control message for the call ID field (bytes 12-13). FortiOS translates the call ID so that it is unique across multiple calls from the same translated client IP. After receiving outgoing call response message, the session helper holds this message and opens a port that accepts GRE traffic that the PPTP server sends. An outgoing call request message contains the following parts:

- The protocol used for the outgoing call request message (usually GRE)
- Source IP address (PPTP server IP)
- Destination IP address (translated client IP)
- Destination port number (translated client call ID)

The session helper identifies an outgoing call reply message using the control message type field (bytes 8-9) with the value 8. The session helper parses these control messages for the call ID field (bytes 12-13) and the client's call ID (bytes 14-15). The session helper then uses the client's call ID value to find the mapping created for the other direction, and then opens a pinhole to accept the GRE traffic that the client sends.

An outgoing call reply message contains the following parts:

- Protocol used for the outgoing call reply message (usually GRE)
- Source IP address (PPTP client IP)
- Destination IP address (PPTP server IP)
- Destination port number (PPTP server Call ID)

Each port that the session opens creates a session for data traffic arriving in that direction. The session helper opens the following two data sessions for each tunnel:

- Traffic from the PPTP client to the server, using the server's call ID as the destination port
- Traffic from the PPTP server to the client, using the client's translated call ID as the destination port

The default timeout value of the control connection is 30 minutes. The session helper closes the pinhole when the data session exceeds the timeout value or is idle for an extended period.

## Remote shell session helper (rsh)

Using the remote shell program (RSH), authenticated users can run shell commands on remote hosts. RSH sessions most often use TCP port 514. To accept RSH sessions you must add a security policy with service set to any or to the RSH pre-defined service (which listens on TCP port number 514).

FortiOS automatically invokes the rsh session helper to process all RSH sessions on TCP port 514. The rsh session helper opens ports required for the RSH service to operate through a FortiGate unit running NAT or transparent and supports port translation of RSH traffic.

## Real-Time Streaming Protocol (RTSP) session helper (rtsp)

The Real-Time Streaming Protocol (RTSP) is an application layer protocol often used by SIP to control the delivery of multiple synchronized multimedia streams, for example, related audio and video streams. Although RTSP is capable of delivering the data streams itself it is usually used like a network remote control for multimedia servers. The protocol is intended for selecting delivery channels (like UDP, multicast UDP, and TCP) and for selecting a delivery mechanism based on the Real-Time Protocol (RTP). RTSP may also use the SIP Session Description Protocol (SDP) as a means of providing information to clients for aggregate control of a presentation consisting of streams from one or more servers, and non-aggregate control of a presentation consisting of multiple streams from a single server.

To accept RTSP sessions you must add a security policy with service set to any or to the RTSP pre-defined service (which listens on TCP ports 554, 770, and 8554 and on UDP port 554). The rtsp session helper listens on TCP ports 554, 770, and 8554.

The rtsp session help is required because RTSP uses dynamically assigned port numbers that are communicated in the packet body when end points establish a control connection. The session helper keeps track of the port numbers and opens pinholes as required. In Network Address Translation (NAT) mode, the session helper translates IP addresses and port numbers as necessary.

In a typical RTSP session the client starts the session (for example, when the user selects the Play button on a media player application) and establishes a TCP connection to the RTSP server on port 554. The client then sends an OPTIONS message to find out what audio and video features the server supports. The server responds to the OPTIONS message by specifying the name and version of the server, and a session identifier, for example, 24256-1.

The client then sends the DESCRIBE message with the URL of the actual media file the client wants to play. The server responds to the DESCRIBE message with a description of the media in the form of SDP code. The client then sends the SETUP message, which specifies the transport mechanisms acceptable to the client for streamed media, for example RTP/RTCP or RDT, and the ports on which it receives the media.

In a NAT configuration the rtsp session helper keeps track of these ports and addresses translates them as necessary. The server responds to the SETUP message and selects one of the transport protocols. When both client and server agree on a mechanism for media transport the client sends the PLAY message, and the server begins streaming the media.

## Session Initiation Protocol (SIP) session helper (sip)

The sip session helper is described in the VoIP Solutions: SIP Guide.

## Trivial File Transfer Protocol (TFTP) session helper (tftp)

To accept TFTP sessions you must add a security policy with service set to any or to the TFTP pre-defined service (which listens on UDP port number 69). The TFTP session helper also listens on UTP port number 69.

TFTP initiates transfers on UDP port 69, but the actual data transfer ports are selected by the server and client during initialization of the connection. The tftp session helper reads the transfer ports selected by the TFTP client and server during negotiation and opens these ports on the firewall so that the TFTP data transfer can be completed. When the transfer is complete the tftp session helper closes the open ports.

## Oracle TNS listener session helper (tns)

The Oracle Transparent Network Substrate (TNS) listener listens on port TCP port 1521 for network requests to be passed to a database instance. The Oracle TNS listener session helper (tns) listens for TNS sessions on TCP port 1521. TNS is a foundation technology built into the Oracle Net foundation layer and used by SQLNET.

# Advanced concepts

This chapter provides configuration concepts and techniques to enhance your network security.

This section includes the topics:

- [Dual internet connections \(redundant Internet connections\)](#)
- [Single firewall vs. multiple virtual domains](#)
- [Modem](#)
- [FortiExtender](#)
- [DHCP servers and relays](#)
- [Assigning IP address by MAC address](#)
- [DNS services](#)
- [Dynamic DNS](#)
- [FortiClient discovery and registration](#)
- [IP addresses for self-originated traffic](#)
- [Administration for schools](#)
- [Replacement messages list](#)
- [Disk](#)
- [CLI Scripts](#)
- [Rejecting PING requests](#)
- [Opening TCP 113](#)
- [Obfuscate HTTP responses](#)

## Dual internet connections (redundant Internet connections)

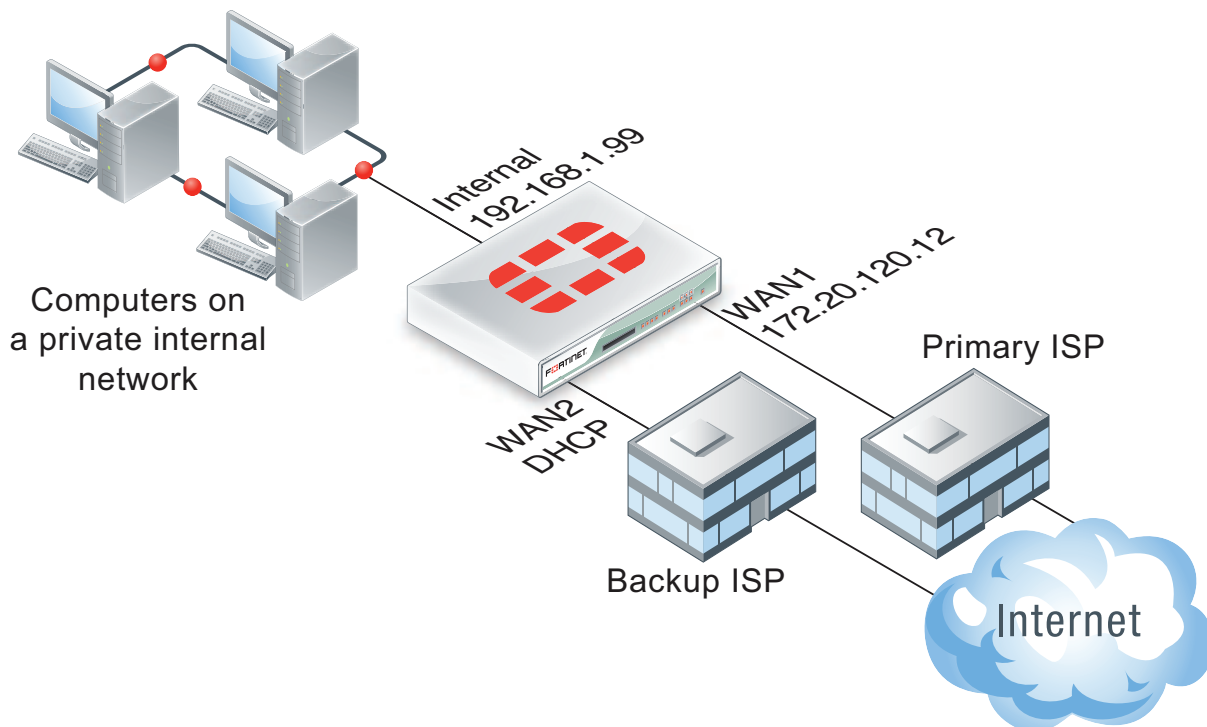
Dual internet connection, dual WAN, or redundant internet connection refers to using two FortiGate interfaces to connect to the Internet. Dual internet connections can be used in three ways:

- Redundant interfaces, should one interface go down, the second automatically becomes the main internet connection
- For load sharing to ensure better throughput.
- A combination of redundancy and load sharing.

### Redundant interfaces

Redundant interfaces, ensures that should your internet access be no longer available through a certain port, the FortiGate unit will use an alternate port to connect to the Internet.

## Configuring redundant interfaces



In this scenario, two interfaces, WAN1 and WAN2 are connected to the Internet using two different ISPs. WAN1 is the primary connection. In an event of a failure of WAN1, WAN2 automatically becomes the connection to the Internet. For this configuration to function correctly, you need to configure three specific settings:

- Configure a link health monitor to determine when the primary interface (WAN1) is down and when the connection returns
- Configure a default route for each interface.
- Configure security policies to allow traffic through each interface to the internal network.

## Link Health Monitor

Adding a link health monitor is required for routing fail over traffic. A link health monitor will confirm the connectivity of the device's interface

### To add a link health monitor - web-based manager

1. Go to **Router > Static > Settings** and select **Create New**.  
For low-end FortiGate units, go to **System > Network > Routing** and select **Create New**.
2. Choose a name.
3. Select the **Interface** that will send probe requests.
4. Specify the **Gateway** IP address if required, if not keep it set to **0.0.0.0**.
5. Make sure that **Health Check** is enabled.
6. Set the **Probe Type** to **Ping** or **HTTP**.
7. For the **Server** field, enter the IP address of a server that the FortiGate unit will send ping or http requests to.

8. For the **Ping Interval**, enter the number of seconds to send ping requests.
9. For the **Failover Threshold**, enter the number of lost pings or http requests is acceptable before the port is determined to be down.
10. Make sure to enable **Update Routing Table when Gateway Detection Status Changes**.
11. Enable **Bring Down (Up)** and select **WAN2** interface.
12. Select **OK**.

### To add a link health monitor - CLI

```
config system link-monitor
edit "Example1"
    set srcint <Interface_sending_probe>
    set server <ISP_IP_address>
    set protocol <Ping or http>
    set gateway-ip <the_gateway_IP_to_reach_the_server_if_required>
    set failtime <failure_count>
    set interval <seconds>
    set update-cascade-interface enable
    set update-static-route enable
    set status enable
end
```

## Routing

You need to configure a default route for each interface and indicate which route is preferred by specifying the distance. The lower distance is declared active and placed higher in the routing table.



When you have dual WAN interfaces that are configured to provide fail over, you might not be able to connect to the backup WAN interface because the FortiGate unit may not route traffic (even responses) out of the backup interface. The FortiGate unit performs a reverse path lookup to prevent spoofed traffic. If no entry can be found in the routing table which sends the return traffic out the same interface, then the incoming traffic is dropped.

### To configure the routing of the two interfaces - web-based manager

1. Go to **Router > Static > Static Routes** and select **Create New Route** or **IPv6 Route**.  
For low-end FortiGate units, go to **System > Network > Routing** and select **Create New Route** or **IPv6 Route**.
2. Set the **Destination IP/Mask** to the address and netmask of 0.0.0.0/0.0.0.0 if it's an IPv4 route. If it's an IPv6 route, set **Destination IP/Mask** to the address and netmask of ::/0
3. Select the **Device** to the primary connection, **WAN1**.
4. Enter the **Gateway** address.
5. Select **Advanced**.
6. Set the **Distance** to 10.
7. Select **OK**.
8. Repeat steps 1 through 7 setting the **Device** to **WAN2** and a **Distance** of 20.

### To configure the IPv4 routing of the two interfaces - CLI

```
config router static
```

```
edit 0
    set dst 0.0.0.0 0.0.0.0
    set device WAN1
    set gateway <gateway_address>
    set distance 10
next
edit 0
    set dst 0.0.0.0 0.0.0.0
    set device WAN2
    set gateway <gateway_address>
    set distance 20
next
end
```

### To configure the IPv6 routing of the two interfaces - CLI

```
config router static6
edit 0
    set dst ::/0
    set device WAN1
    set gateway <gateway_address>
    set distance 10
next
edit 0
    set dst ::/0
    set device WAN2
    set gateway <gateway_address>
    set distance 20
next
end
```

## Security policies

When creating security policies, you need to configure duplicate policies to ensure that after traffic fails over WAN1, regular traffic will be allowed to pass through WAN2 as it did with WAN1. This ensures that fail-over will occur with minimal affect to users. For more information on creating security policies see the Firewall Guide.

## Load sharing

Load sharing enables you to use both connections to the internet at the same time, but do not provide fail over support. When configuring for load sharing, you need to ensure routing is configured for both external ports, for example, WAN1 and WAN2, have static routes with the same distance and priority.

Further configuration can be done using Equal Cost Multiple Path (ECMP). For more information on ECMP and load sharing, see the Advanced Routing Guide.

## Link redundancy and load sharing

In this scenario, both links are available to distribute Internet traffic over both links. Should one of the interfaces fail, the FortiGate unit will continue to send traffic over the other active interface. Configuration is similar to the Redundant interfaces configuration, with the main difference being that the configured routes should have equal distance settings.



This means both routes will remain active in the routing table. To make one interface the preferred interface, use a default policy route to indicate the interface that is preferred for accessing the Internet. If traffic matches the security policy, the policy overrides all entries in the routing table, including connected routes. You may need to add a specific policy routes that override these default policy routes.

To redirect traffic over the secondary interface, create policy routes to direct some traffic onto it rather than the primary interface. When adding the policy route, only define the outgoing interface and leave the gateway blank. This ensures that the policy route will not be active when the link is down.

## Single firewall vs. multiple virtual domains

A typical FortiGate setup, with a small to mid-range appliance, enables you to include a number of subnets on your network using the available ports and switch interfaces. This can potentially provide a means of having three or more mini networks for the various groups in a company. Within this infrastructure, multiple network administrators have access to the FortiGate to maintain security policies.

However, the FortiGate unit may not have enough interfaces to match the number of departments in the organization. If the FortiGate unit is running in transparent mode however, there is only one interface, and multiple network branches through the FortiGate are not possible.

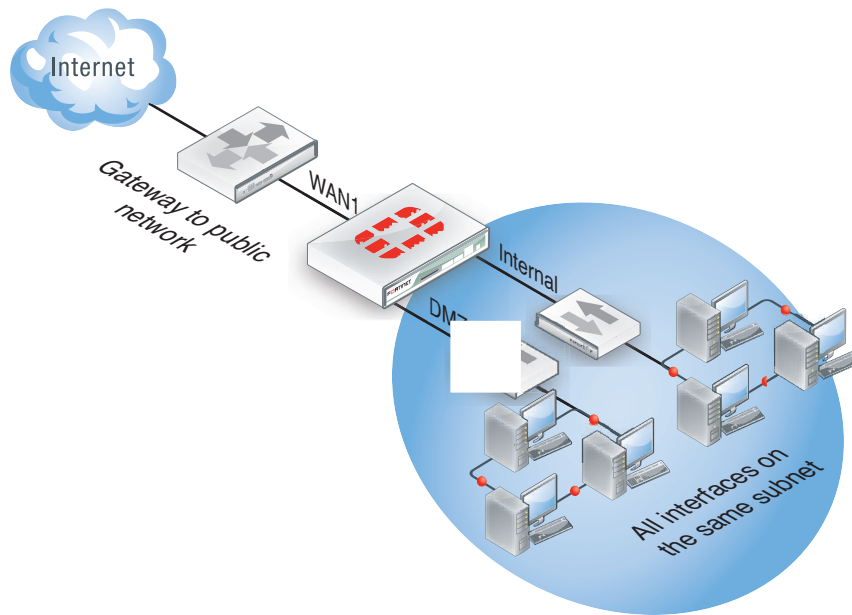
A FortiGate unit with Virtual Domains (VDOMs) enabled, provides a means to provide the same functionality in transparent mode as a FortiGate in NAT mode. VDOMs are a method of dividing a FortiGate unit into two or more virtual units that function as multiple independent units. VDOMs can provide separate security policies and, in NAT mode, completely separate configurations for routing and VPN services for each connected network. For administration, an administrator can be assigned to each VDOM, minimizing the possibility of error or fouling network communications.

By default, your FortiGate unit supports a maximum of 10 VDOMs. For FortiGate models 3000 and higher, you can purchase a license key to increase the number of VDOMs to 25, 50, 100 or 250.

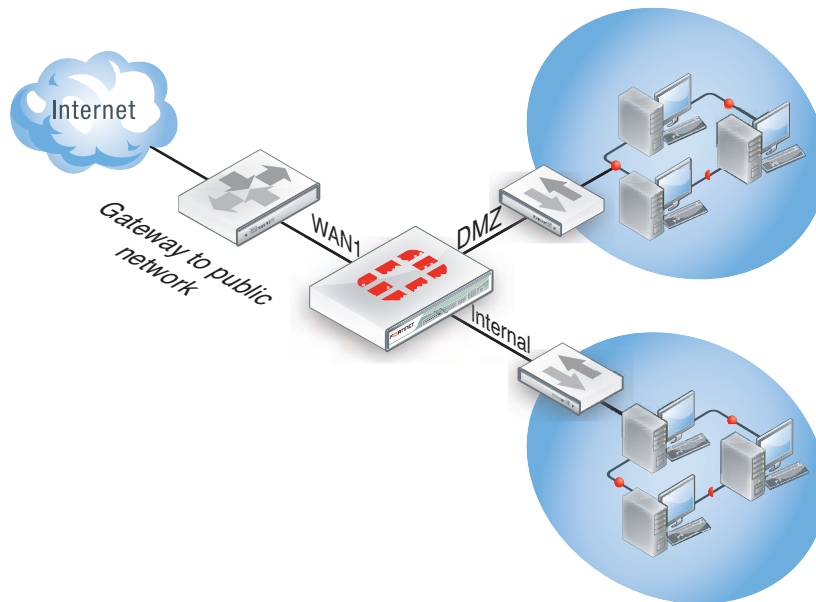
The FortiGate-20C and 30B and FortiWifi-20C and 30B do not support VDOMs.

## Single firewall vs. vdoms

When VDOMs are not enabled, and the FortiGate unit is in transparent mode, all the interfaces on your unit become broadcast interfaces. The problem is there are no interfaces free for additional network segments.



A FortiGate with three interfaces means only limited network segments are possible without purchasing more FortiGate devices.



With multiple VDOMs you can have one of them configured in transparent mode, and the rest in NAT mode. In this configuration, you have an available transparent mode FortiGate unit you can drop into your network for troubleshooting, and you also have the standard.

This example shows how to enable VDOMs on the FortiGate unit and the basic and create a VDOM accounting on the DMZ2 port and assign an administrator to maintain the VDOM. First enable Virtual Domains on the FortiGate unit.

**To enable VDOMs - web-based manager**

1. Go to **System > Dashboard > Status**.
2. In the **System Information** widget, select **Enable** for **Virtual Domain**.

Note that on FortiGate-60 series and lower models, you need to enable VDOMs in the CLI only.

The FortiGate unit logs you out. Once you log back in, you will notice that the menu structure has changed. This reflects the global settings for all Virtual Domains.

**To enable VDOMs - CLI**

```
config system global
    set vdom-admin enable
end
```

Next, add the VDOM called accounting.

**To add a VDOM - web-based manager**

1. Go to **Global > VDOM > VDOM**, and select **Create New**.
2. Enter the VDOM name `accounting`.
3. Select **OK**.

**To add a VDOM - CLI**

```
config vdom
    edit <new_vdom_name>
end
```

With the Virtual Domain created, you can assign a physical interface to it, and assign it an IP address.

**To assign physical interface to the accounting Virtual Domain - web-based manager**

1. Go to **Global > Network > Interface**.
2. Select the DMZ2 port row and select **Edit**.
3. For the **Virtual Domain** drop-down list, select **accounting**.
4. Select the **Addressing Mode** of **Manual**.
5. Enter the IP address for the port of 10.13.101.100/24.
6. Set the **Administrative Access** to **HTTPS** and **SSH**.
7. Select **OK**.

**To assign physical interface to the accounting Virtual Domain - CLI**

```
config global
    config system interface
        edit dmz2
            set vdom accounting
            set ip 10.13.101.100/24
            set allowaccess https ssh
        next
    end
```

## Modem

FortiGate units support the use of wireless, 3G and 4G modems connected using the USB port or, if available, the express card slot. Modem access provides either primary or secondary (redundant) access to the Internet. For FortiGate units that do not include an internal modem (those units with an “M” designation), the modem interface will not appear in the web-based manager until enabled in the CLI. To enable the modem interface enter the CLI commands:

```
config system modem
    set status enable
end
```

You will need to log out of the FortiGate and log back in to see the modem configuration page at **System > Network > Modem**. Once enabled, modem options become available by going to **System > Network > Interface**.

Note that the modem interface is only available when the FortiGate unit is in NAT mode.

To configure modem settings, go to **System > Network > Modem**.

Configuring the modem settings is a matter of entering the ISP phone number, user name and password. Depending on the modem, additional information may need to be supplied such as product identifiers, and initialization strings.

The FortiGate unit includes a number of common modems within its internal database. You can view these by selecting the **Configure Modem** link on the **Modem Settings** page. If your modem is not on the list, select **Create New** to add the information. This information is stored on the device, and will remain after a reboot.

Fortinet has an online database of modem models and configuration settings through FortiGuard. A subscription to the FortiGuard services is not required to access the information. As models are added, you can select the **Configure Modem** link and select **Update Now** to download new configurations.

## USB modem port

Each USB modem has a specific dial-out port. This will be indicated with the documentation for your modem. To enable the correct USB port, use the CLI commands:

```
config system modem
    set wireless-port {0 | 1 | 2}
end
```

To test the port, use the diagnose command:

```
diagnose sys modem com /1
```

The 1 will be the value of your USB port selected. The response will be:

```
Serial port: /dev/l
Press Ctrl+W to exit.
```

If the port does not respond the output will be:

```
Can not open modem device '/dev/l' : Broken pipe
```

## Modes

The FortiGate unit allows for two modes of operation for the modem; stand alone and redundant. In stand alone mode, the modem connects to a dialup ISP account to provide the connection to the Internet. In redundant mode, the modem acts as a backup method of connecting to the Internet, should the primary port for this function fails.

Configuring either stand alone or redundant modes are very similar. The primary difference is the selection of the interface that the modem will replace in the event of it failing, and the configuration of a PING server to monitor the chosen interface.

### Configuring stand alone mode

Configuring stand alone mode is a matter of configuring the modem information and the dialing mode. The dial mode is either **Always Connect** or **Dial on demand**. Selecting **Always Connect** ensures that once the modem has connected, it remains connected to the ISP. Selecting **Dial on Demand**, the modem only calls the ISP if packets are routed to the modem interface. Once sent, the modem will disconnect after a specified amount of time.

#### To configure standalone mode as needed - web-based manager

1. Go to **System > Network > Modem**.
2. Select the **Mode** of **Standalone**.
3. Select the **Dial Mode** of **Dial on Demand**.
4. Select the number of redials the modem attempts if connection fails to 5.
5. Select **Apply**.

#### To configure standalone mode as needed- CLI

```
config system modem
  set status enable
  set mode standalone
  set auto-dial enable
  set redial 5
end
```

### Configuring redundant mode

Redundant mode provides a backup to an interface, typically to the Internet. If that interface fails or disconnects, the modem automatically dials the configured phone number(s). Once connected, the FortiGate unit routes all traffic to the modem interface until the monitored interface is up again. The FortiGate unit pings the connection to determine when it is back online.

For the FortiGate to verify when the interface is back up, you need to configure a Ping server for that interface. You will also need to configure security policies between the modem interface and the other interfaces of the FortiGate unit to ensure traffic flow.

#### To configure redundant mode as needed - web-based manager

1. Go to **System > Network > Modem**.
2. Select the **Mode** of **Redundant**.

3. Select the interface the modem takes over from if it fails.
4. Select the **Dial Mode** of **Dial on Demand**.
5. Select the number of redials the modem attempts if connection fails to 5.
6. Select **Apply**.

#### To configure standalone mode as needed- CLI

```
config system modem
    set status enable
    set mode redundant
    set interface wan1
    set auto-dial enable
    set redial 5
end
```

### Link Health Monitor

Adding a link health monitor is required for routing fail over traffic. A link health monitor will confirm the connectivity of the device's interface

#### To add a link health monitor - web-based manager

1. Go to **Router > Static > Settings** and select **Create New**.  
For low-end FortiGate units, go to **System > Network > Routing** and select **Create New**.
2. Choose a name.
3. Select the **Interface** that will send probe requests which is the modem.
4. Specify the **Gateway** IP address if required, if not keep it set to *0.0.0.0*.
5. Make sure that **Health Check** is enabled.
6. Set the **Probe Type** to **Ping** or **HTTP**.
7. For the **Server** field, enter the IP address of a server that the FortiGate unit will send ping or http requests to.
8. For the **Ping Interval**, enter the number of seconds to send ping requests.
9. For the **Failover Threshold**, enter the number of lost pings or http requests is acceptable before the port is determined to be down.
10. Make sure to enable **Update Routing Table when Gateway Detection Status Changes**.
11. Enable **Bring Down (Up)** and select the redundant interface.
12. Select **OK**.

#### To add a link health monitor - CLI

```
config system link-monitor
    edit "Example1"
        set srcint <Interface_sending_probe>
        set server <ISP_IP_address>
        set protocol <Ping or http>
        set gateway-ip <the_gateway_IP_to_reach_the_server_if_required>
        set failtime <failure_count>
        set interval <seconds>
        set update-cascade-interface enable
        set update-static-route enable
        set status enable
    end
```

## Additional modem configuration

The CLI provides additional configuration options when setting up the modem options including adding multiple ISP dialing and initialization options and routing. For more information, see the CLI Reference.

## Modem interface routing

The modem interface can be used in FortiOS as a dedicated interface. Once enabled and configured, you can use it in security policies and define static and dynamic routing. Within the CLI commands for the modem, you can configure the distance and priority of routes involving the modem interface. The CLI commands are:

```
config sysetm modem
  set distance <route_distance>
  set priority <priority_value>
end
```

For more information on the routing configuration in the CLI, see the CLI Reference. For more information on routing and configuring routing, see the Advanced Routing Guide.

## FortiExtender

FortiGate units support the use of wireless, 3G and 4G modems connected to a FortiExtender which will be connected to the FortiGate unit.

## Installing the 3G/4G modem

Remove the housing cover of the FortiExtender and use the provided USB extension cable to connect your 3G/4G modem to the device.

For more information on installing the 3G/4G modem, see the [QuickStart Guide](#).

## Connecting the FortiExtender unit

### If you are using the provided PoE injector:

1. Plug the provided Ethernet cable into the Ethernet port of the FortiExtender and insert the other end of the Ethernet cable into the AP/Bridge port on the injector, then plug the injector into an electrical outlet.
2. Connect the LAN port of the PoE injector to a FortiGate, FortiWifi, or FortiSwitch device.

### If you are not using the PoE injector:

1. Insert the other end of the Ethernet cable into a PoE LAN port on an appropriate FortiGate, FortiWifi or FortiSwitch device.

For more information on connecting the FortiExtender unit, see the [QuickStart Guide](#).

Once connected, your FortiGate appliance can automatically detect, connect with, and control the FortiExtender and modem via a CAPWAP tunnel. To do this, FortiExtender and FortiGate must be on the same Layer 2/3

subnet (or have DHCP relay between) and FortiGate must respond to FortiExtender's request. In this example FortiExtender is connected to the **lan** interface of the FortiGate unit.

By default, FortiExtender is hidden and disabled. Enable it in FortiGate's CLI:

```
config system global
    set fortiextender enable
    set wireless-controller enable
end
```

The control and provisioning of Wireless Access Point (CAPWAP) service must be enabled on the port to which the FortiExtender unit is connected (**lan** interface in this example) using the following CLI commands:

```
config system interface
    edit lan
        set allowaccess capwap
    end
```

Once FortiExtender is discovered and authorized, a virtual WAN interface such as **text-wan1** is created on the Fortigate.

## Configuring the FortiExtender unit

At this point, you can fully manage the FortiExtender from the FortiGate unit. To achieve this, you need to authorize the FortiExtender by going to **System > Network > FortiExtender** and click on **Authorize**. Once authorized, you can configure you device as required:

**Link Status:** Shows you if the link is **Up** or **Down**, click on **Details** to see the System and Modem Status.

**IP Address:** Shows you the current FortiExtender's IP address, click on the link of the IP address to connect to the FortiExtender GUI.

**OS Version:** Shows the current FortiExtender's build, click on **Upgrade** if you wish to upgrade the Firmware.

**Configure Settings:** Allows you to configure the Modem Settings, PPP Authentication, General, GSM / LTE, and CDMA.

**Diagnostics:** Allows you to diagnose the FortiExtender unit, you can choose a command from the existing commands and click on **Run**.

Existing commands are: Show device info, Show data session connection status, test connection, test disconnection, Get signal strength, AT Command.

**Simple output of Show device info:**

```
Manufacturer: Sierra Wireless, Incorporated
Model: AirCard 330U
Revision: SWI9200X_03.00.08.03AP R4019 CARMD-EN-10527 2011/12/07 18:43:13
IMEI: 359615040996060
IMEI SV: 7
FSN: CDU3153118210
3GPP Release 8
+GCAP: +CGSM
OK
```

## Modem Settings

The FortiExtender unit allows for two modes of operation for the modem; **On Demand** and **Always Connect**.



In **On Demand** mode, the modem connects to an ISP only upon execution of the dial up operation and disconnects only upon subsequent hang up operation from the CLI.

### Syntax

To connect, run the following CLI command:

```
execute extender dial <SN> // <SN> is the FortiExtender's serial number.
```

To disconnect, run the following CLI command:

```
execute extender hangup <SN> // <SN> is the FortiExtender's serial number.
```

In **Always Connect** mode, the modem is always connected to the internet, it can act as a primary or backup method of connecting to the Internet.

By default, the FortiExtender will be in **Always Connect** mode once authorized.

**Modem Settings** is a matter of configuring the dialing mode. The **dial mode** is either **Always Connect** or **On demand**. Selecting **Always Connect** ensures that once the modem has connected, it remains connected to the ISP.

### To configure the dial mode as needed - web-based manager

1. Go to **System > Network > FortiExtender** and click **Configuring Settings**.
2. Extend **Modem Settings**.
3. Select the **Dial Mode** of **Always Connect** or **On Demand**.
4. Enter the **Redial Limit** to 5 - Only applicable in **On Demand** mode.
5. If needed, enter the **Quota Limit** to the desired limit in Mega Byte - The recorded quota usage values are not persistent and lost upon rebooting Fortigate.
6. Select **Ok**.

## Configuring the FortiGate unit

In order to allow inbound and outbound traffic through the 3G/4G modem, you need to add a security policy and, depending on the scenario, a static route in the FortiGate unit.

### Adding a policy

If your network will be using IPv4 addresses, go to **Policy & Objects > Policy > IPv4** and select **Create New** to add a policy that allows users on the private network to access the Internet.

In the policy, set the **Incoming Interface** to the internal interface and the **Outgoing Interface** to **fext-wan1** interface. You will also need to set **Source Address**, **Destination Address**, **Schedule**, and **Service** according to your network requirements.

Make sure the **Action** is set to **ACCEPT**. Turn on **NAT** and make sure **Use Destination Interface Address** is selected. Select **OK**.

### Always-on, redundant of wan1

No route required as in FortiOS 5.2.2 the routing shows only active routes.

Use the following CLI command to show all routes:

```
get router info routing-table all
```

### Sample Output

```
Codes: K - kernel, C - connected, S - static, R - RIP, B - BGP
O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
* - candidate default
S* 0.0.0.0/0 [10/0] via 172.20.120.2, wan1
C 25.49.248.0/24 is directly connected, fext-wan1
C 169.254.1.1/32 is directly connected, ssl.root
is directly connected, ssl.root
C 172.20.120.0/24 is directly connected, wan1
C 192.168.1.0/24 is directly connected, lan
```

### Always-on, with select traffic going through the FortiExtender

In this scenario, a static route is required, if your network using IPv4 addresses, go to **Router > Static > Static Routes** or **System > Network > Routing**, depending on your FortiGate model, and select **Create New**. Set the **Destination IP/Mask** to 0.0.0.0/0.0.0.0, **Device** to **fext-wan1**, and set the **Gateway** to your gateway IP or to the next hop router, depending on your network requirements. Select **OK**.

### ECMP across fext-wan1 and wan1

Go to **Router > Static > Settings** to configure **ECMP Load Balancing Method**, choose between **Source IP based**, **Weighted Load Balance**, **Spillover**, **Source-Destination IP based** and configure your settings as required.

Go to **System > Network > Interfaces** and edit **fext-wan1**, set the **distance** to the same distance as wan1 interface under **Router > Static > Static Routes** (in this example distance =10)

Now the traffic is shared between **wan1** and **fext-wan1** links respecting the **ECMP Load Balancing Method** used.

This deployment can be extrapolated for dual FortiExtender installation.

## DHCP servers and relays

Note that DHCP server options are not available in transparent mode.

A DHCP server provides an address to a client on the network, when requested, from a defined address range.

An interface cannot provide both a server and a relay for connections of the same type (regular or IPsec). However, you can configure a Regular DHCP server on an interface only if the interface is a physical interface with a static IP address. You can configure an IPsec DHCP server on an interface that has either a static or a dynamic IP address.

You can configure one or more DHCP servers on any FortiGate interface. A DHCP server dynamically assigns IP addresses to hosts on the network connected to the interface. The host computers must be configured to obtain their IP addresses using DHCP.

If an interface is connected to multiple networks via routers, you can add a DHCP server for each network. The IP range of each DHCP server must match the network address range. The routers must be configured for DHCP relay.

You can configure a FortiGate interface as a DHCP relay. The interface forwards DHCP requests from DHCP clients to an external DHCP server and returns the responses to the DHCP clients. The DHCP server must have appropriate routing so that its response packets to the DHCP clients arrive at the unit.

## DHCP Server configuration

To add a DHCP server, go to **System > Network > Interface**. Edit the interface, and select **Enable** for the **DHCP Server** row.

<b>DHCP Server IP</b>	This appears only when <b>Mode</b> is <b>Relay</b> . Enter the IP address of the DHCP server where the FortiGate unit obtains the requested IP address.
<b>Address Range</b>	By default, the FortiGate unit assigns an address range based on the address of the interface for the complete scope of the address. For example, if the interface address is 172.20.120.230, the default range created is 172.20.120.231 to 172.20.120.254. Select the range and select <b>Edit</b> to adjust the range as needed, or select <b>Create New</b> to add a different range.
<b>Netmask</b>	Enter the netmask of the addresses that the DHCP server assigns.
<b>Default Gateway</b>	Select to either use the same IP as the interface or select <b>Specify</b> and enter the IP address of the default gateway that the DHCP server assigns to DHCP clients.
<b>DNS Server</b>	Select to use the system's DNS settings or select <b>Specify</b> and enter the IP address of the DNS server.
<b>Advanced... (expand to reveal more options)</b>	
<b>Mode</b>	Select the type of DHCP server the FortiGate unit will be. By default, it is a server. Select <b>Relay</b> if needed. When <b>Relay</b> is selected, the above configuration is replaced by a field to enter the <b>DHCP Server IP</b> address.
<b>Type</b>	Select to use the DHCP in regular or IPsec mode.
<b>MAC Address Access Control List</b>	<p>Select to match an IP address from the DHCP server to a specific client or device using its MAC address.</p> <p>In a typical situation, an IP address is assigned ad hoc to a client, and that assignment times out after a specific time of inactivity from the client, known as the lease time. To ensure a client or device always has the same IP address, that is, there is no lease time, use IP reservation.</p>
<b>Add from DHCP Client List</b>	If the client is currently connected and using an IP address from the DHCP server, you can select this option to select the client from the list.

## DHCP in IPv6

You can use DHCP with IPv6 using the CLI. To configure DHCP, ensure IPv6 is enabled by going to **System > Config > Features** and enable **IPv6**. Use the CLI command

```
config system dhcp6 server
```

For more information on the configuration options, see the CLI Reference.

## Service

On low-end FortiGate units, a DHCP server is configured, by default on the Internal interface:

<b>IP Range</b>	192.168.1.110 to 192.168.1.210
<b>Netmask</b>	255.255.255.0
<b>Default gateway</b>	192.168.1.99
<b>Lease time</b>	7 days
<b>DNS Server 1</b>	192.168.1.99

These settings are appropriate for the default Internal interface IP address of 192.168.1.99. If you change this address to a different network, you need to change the DHCP server settings to match.

Alternatively, after the FortiGate unit assigns an address, you can go to **System > Monitor > DHCP Monitor**, locate the particular user. Select the check box for the user and select **Add to Reserved**.

## Lease time

The lease time determines the length of time an IP address remains assigned to a client. Once the lease expires, the address is released for allocation to the next client request for an IP address. The default lease time is seven days. To change the lease time, use the following CLI commands:

```
config system dhcp server
  edit <server_entry_number>
    set lease-time <seconds>
  end
```

To have an unlimited lease time, set the value to zero.

## DHCP options

When adding a DHCP server, you have the ability to include DHCP codes and options. The DHCP options are BOOTP vendor information fields that provide additional vendor-independent configuration parameters to manage the DHCP server. For example, you may need to configure a FortiGate DHCP server that gives out a separate option as well as an IP address. For example, an environment that needs to support PXE boot with Windows images.

The option numbers and codes are specific to the particular application. The documentation for the application will indicate the values to use. Option codes are represented in a option value/HEX value pairs. The option is a value 1 and 255.

You can add up to three DHCP code/option pairs per DHCP server.

#### To configure option 252 with value `http://192.168.1.1/wpad.dat` - CLI

```
config system dhcp server
  edit <server_entry_number>
    set option1 252 687474703a2f2f3139322e3136382e312e312f777061642e646174
  end
```

For detailed information about DHCP options, see [RFC 2132](#), DHCP Options and BOOTP Vendor Extensions.

## Exclude addresses in DHCP a range

If you have a large address range for the DHCP server, you can block a range of addresses that will not be included in the available addresses for the connecting users. To do this, go to the CLI and enter the commands:

```
config system dhcp server
  edit <server_entry_number>
    config exclude-range
      edit <sequence_number>
        set start-ip <address>
        set end-ip <address>
      end
    end
  end
```

## DHCP Monitor

To view information about DHCP server connections, go to **System > Monitor > DHCP Monitor**. On this page, you can also add IP address to the reserved IP address list.

## Breaking an address lease

Should you need to end an IP address lease, you can break the lease using the CLI. This is useful if you have limited addresses, longer lease times where leases are no longer necessary. For example, with corporate visitors.

**To break a lease enter the CLI command:**

```
execute dhcp lease-clear <ip_address>
```

## Assigning IP address by MAC address

To prevent users from changing their IP addresses and causing IP address conflicts or unauthorized use of IP addresses, you can bind an IP address to a specific MAC address using DHCP.

Use the CLI to reserve an IP address for a particular client identified by its device MAC address and type of connection. The DHCP server then always assigns the reserved IP address to the client. The number of reserved addresses that you can define ranges from 10 to 200 depending on the FortiGate model.

After setting up a DHCP server on an interface by going to **System > Network > Interface**, select the blue arrow next to **Advanced** to expand the options. If you know the MAC address of the system select **Create New** to add it, or if the system has already connected, locate it in the list, select its check box and select **Add from DHCP Client List**.

You can also match an address to a MAC address in the CLI. In the example below, the IP address 10.10.10.55 is assigned to MAC address 00:09:0F:30:CA:4F.

```
config system dhcp server
  edit 1
    config reserved-address
      edit 1
        set ip 10.10.10.55
        set mac 00:09:0F:30:CA:4F
      end
    end
  end
```

## DNS services

A DNS server is a public service that converts symbolic node names to IP addresses. A Domain Name System (DNS) server implements the protocol. In simple terms, it acts as a phone book for the Internet. A DNS server matches domain names with the computer IP address. This enables you to use readable locations, such as fortinet.com when browsing the Internet. FortiOS supports DNS configuration for both IPv4 and IPv6 addressing.

The FortiGate unit includes default DNS server addresses. However, these should be changed to those provided by your Internet Service Provider. The defaults are DNS proxies and are not as reliable as those from your ISP.

Within FortiOS, there are two DNS configuration options; each provide a specific service, and can work together to provide a complete DNS solution.

## DNS settings

Basic DNS queries are configured on interfaces that connect to the Internet. When a website is requested, for example, the FortiGate unit will look to the configured DNS servers to provide the IP address to know which server to contact to complete the transaction.

DNS server addresses are configured by going to **System > Network > DNS**. Here you specify the DNS server addresses. Typically, these addresses are supplied by your ISP. An additional option is available if you have local Microsoft domains on the network, by entering a domain name in the **Local Domain Name** field.

In a situation where all three fields are configured, the FortiGate unit will first look to the local domain. If no match is found, a request is sent to the external DNS servers.

If virtual domains are enabled, you create a DNS database in each VDOM. All of the interfaces in a VDOM share the DNS database in that VDOM.

## Additional DNS CLI configuration

Further options are available from the CLI with the command `config system dns`. Within this command you can set the following commands:

- `dns-cache-limit` - enables you to set how many DNS entries are stored in the cache. Entries that remain in the cache provide a quicker response to requests than going out to the Internet to get the same information.
- `dns-cache-ttl` - enables you to set how long entries remain in the cache in seconds, between 60 and 86,400 (24 hours).
- `cache-notfound-responses` - when enabled, any DNS requests that are returned with NOTFOUND can be stored in the cache.
- `source-ip` - enables you to define a dedicated IP address for communications with the DNS server.

## DNS server

You can also create local DNS servers for your network. Depending on your requirements, you can manually maintain your entries (master DNS server), or use it as a jumping point, where the server refers to an outside source (slave DNS server). A local master DNS server works similarly to the DNS server addresses configured in **System > Network > DNS**, but all entries must be added manually. This enables you to add a local DNS server to include specific URL/IP address combinations.

The DNS server options are not visible in the web-based manager by default. To enable the server, go to **System > Config > Features** and select **DNS Database**.

While a master DNS server is an easy method of including regularly used addresses to save on going to an outside DNS server, it is not recommended to make it the authoritative DNS server. IP addresses may change, and maintaining any type of list can quickly become labor-intensive.

A FortiGate master DNS server is best set for local services. For example, if your company has a web server on the DMZ that is accessed by internal employees as well as external users, such as customers or remote users. In this situation, the internal users when accessing the site would send a request for `website.example.com`, that would go out to the DNS server on the web, to return an IP address or virtual IP. With an internal DNS, the same site request is resolved internally to the internal web server IP address, minimizing inbound/outbound traffic and access time.

As a slave, DNS server, the FortiGate server refers to an external or alternate source as way to obtain the url/IP combination. This useful if there is a master DNS server for a large company where a list is maintained. Satellite offices can then connect to the master DNS server to obtain the correct addressing.

The DNS server entries does not allow CNAME entries, as per [RFC 1912](#), section 2.4.

### To configure a master DNS server - web-based manager

1. Go to **System > Network > DNS Server**, and select **Create New** for **DNS Database**.
2. Select the **Type** of **Master**.
3. Select the **View** as **Shadow**.
4. The view is the accessibility of the DNS server. Selecting **Public**, external users can access, or use, the DNS server. Selecting **Shadow**, only internal users can use it.
5. Enter the DNS **Zone**, for example, `WebServer`.
6. Enter the domain name for the zone, for example `example.com`.
7. Enter the hostname of the DNS server, for example, `Corporate`.

8. Enter the contact address for the administrator, for example, `admin@example.com`.
9. Set **Authoritative** to **Disable**.
10. Select **OK**.
11. Enter the DNS entries for the server by selecting **Create New**.
12. Select the **Type**, for example, **Address (A)**.
13. Enter the **Hostname**, for example `web.example.com`.
14. Enter the remaining information, which varies depending on the **Type** selected.
15. Select **OK**.

### To configure a DNS server - CLI

```
config system dns-database
  edit WebServer
    set domain example.com
    set type master
    set view shadow
    set ttl 86400
    set primary-name corporate
    set contact admin@example.com
    set authoritative disable
    config dns-entry
      edit 1
        set hostname web.example.com
        set type A
        set ip 192.168.21.12
        set status enable
      end
    end
  end
```

## Recursive DNS

You can set an option to ensure these types of DNS server is not the authoritative server. When configured, the FortiGate unit will check its internal DNS server (Master or Slave). If the request cannot be fulfilled, it will look to the external DNS servers. This is known as a split DNS configuration.

You can also have the FortiGate unit look to an internal server should the Master or Slave not fulfill the request by using the CLI commands:

```
config system dns-database
  edit example.com
    ...
    set view shadow
  end
```

For this behavior to work completely, for the external port, you must set the DNS query for the external interface to be recursive. This option is configured in the CLI only.

### To set the DNS query

```
config system dns-server
  edit wan1
    set mode recursive
  end
```



## Dynamic DNS

If your ISP changes your external IP address on a regular basis, and you have a static domain name, you can configure the external interface to use a dynamic DNS service to ensure external users and/or customers can always connect to your company firewall.

If you have a FortiGuard subscription, you can use FortiGuard as your DDNS server. To configure dynamic DNS in the web-based manager, go to **System > Network > DNS**, select **Enable FortiGuard DDNS**, and enter the relevant information for the interface communicating to the server, and which server to use, and relevant information.

If you do not have a FortiGuard subscription, or want to use an alternate server, you can configure dynamic DNS in the CLI use the commands below. Within the CLI you can configure a DDNS for each interface. Only the first configured port appears in the web-based manager. Additional commands vary with the DDNS server you select.

```
config system ddns
  edit <instance_value>
    set monitor-interface <external_interface>
    set ddns-server <ddns_server_selection>
  end
```

You can also use FortiGuard (when subscribed) as a DDNS as well. To configure, use the CLI commands:

```
config system fortiguard
  set ddns-server-ip
  set ddns-server-port
end
```

## FortiClient discovery and registration

FortiOS provides a means of allowing users running FortiClient Endpoint Control software to connect to specific interfaces when connecting to the FortiGate unit. As well as ensuring that remote or local users have FortiClient Endpoint Control software installed on their PC or mobile device.

### FortiClient discovery

You can configure a FortiGate interface as an interface that will accept FortiClient connections. When configured, the FortiGate unit sends broadcast messages which the FortiClient software running on an end user PC is listening for.

#### To enable the broadcast message

1. Go to **System > Network > Interface**.
2. Edit the interface to send the broadcast messages.
3. Select **FCT-Access**.
4. In **Device Management**, select **Broadcast Discovery Messages**.
5. Select **OK**.

Once enabled, the FortiGate unit broadcasts a discovery message that includes the IP address of the interface and listening port number to the local network. All PCs running FortiClient on that network listen for this discovery message.

You also have the option of including a registration key. When the FortiClient discovers the FortiGate unit, it is prompted to enter a registration key, defined by the administrator.

#### To add a registration key

1. Go to **System > Config > Advanced**.
2. Select **Enable Registration Key for FortiClient**, and enter the key.
3. Select **Apply**.

Ensure you distribute the key to the users that need to connect to the FortiGate unit.

## FortiClient Registration

On the end user side, if FortiClient has not been registered with the FortiGate unit, it is continually listening for the FortiGate discovery message. When this message is detected the un-registered client will pop-up a FortiGate Detected message. The user can choose to either register or ignore the message.

Clients that have registered with that FortiGate unit will not be listening for these messages and will not display the message again.

If you enabled the registration key, the user is prompted to enter the key before a connection can be completed.



There can be some confusion when discussing the compatibility of FortiClient with FortiGate. There is technical compatibility and licensing compatibility. FortiClient software may not be licence compatible with previous versions of FortiOS.

For instance, while FortiClient 5.2 software is technologically compatible with a FortiGate running FortiOS 5.0 firmware. A FortiGate running FortiOS 5.0 will not recognize the FortiClient 5.2 licence code. Depending on the restrictions of your particular situation, you can:

- Use FortiClient 5.2 without licensing
- Use FortiClient 5.0 with licensing
- Upgrade to FortiOS firmware 5.2

For more information on FortiGate registration, see the FortiClient Administration Guide.

## IP addresses for self-originated traffic

On the FortiGate unit, there are a number of protocols and traffic that is specific to the internal workings of FortiOS. For many of these traffic sources, you can identify a specific port/IP address for this self-originating traffic. The following traffic can be configured to a specific port/IP address:

- SNMP
- Syslog

- alert email
- FortiManager connection IP
- FortiGuard services
- FortiAnalyzer logging
- NTP
- DNS
- Authorization requests such as RADIUS
- FSSO

Configuration of these services is performed in the CLI. In each instance, there is a command `set source-ip`. For example, to set the source IP of NTP to be on the DMZ1 port with an IP of 192.168.4.5, the commands are:

```
config system ntp
  set ntpsync enable
  set syncinterval 5
  set source-ip 192.168.4.5
end
```

To see which services are configured with source-ip settings, use the `get` command:

```
get system source-ip status
```

The output will appear similar to the sample below:

```
NTP: x.x.x.x
DNS: x.x.x.x
SNMP: x.x.x.x
Central Management: x.x.x.x
FortiGuard Updates (AV/IPS): x.x.x.x
FortiGuard Queries (WebFilter/SpamFilter): x.x.x.x
```

## Administration for schools

For system administrator in the school system it is particularly difficult to maintain a network and access to the Internet. There are potential legal liabilities if content is not properly filtered and children are allowed to view pornography and other non-productive and potentially dangerous content. For a school, too much filtering is better than too little. This section describes some basic practices administrators can employ to help maintain control without being too draconian for access to the internet.

### Security policies

The default security policies in FortiOS allow all traffic on all ports and all IP addresses. Not the most secure. While applying UTM profiles can help to block viruses, detect attacks and prevent spam, this doesn't provide a solid overall security option. The best approach is a layered approach; the first layer being the security policy.

When creating outbound security policies, you need to know the answer to the question "What are the students allowed to do?" The answer is surf the web, connect to FTP sites, send/receive email, and so on.

Once you know what the students need to do, you can research the software used and determine the ports the applications use. For example, if the students only require web surfing, then there are only two ports (80 - HTTP and 443 - HTTPS) needed to complete their tasks. Setting the security policies to only allow traffic through two

ports (rather than all 65,000), this will significantly lower any possible exploits. By restricting the ports to known services, means stopping the use of proxy servers, as many of them operate on a non-standard port to hide their traffic from URL filtering or HTTP inspection.

## DNS

Students should not be allowed to use whatever DNS they want. this opens another port for them to use and potentially smuggle traffic on. The best approach is to point to an internal DNS server and only allow those devices out on port 53. Its the same approach one would use for SMTP. Only allow the mail server to use port 25 since nothing else should be sending email.

If there is no internal DNS server, then the list of allowed DNS servers they can use should be restrictive. One possible exploit would be for them to set up their own DNS server at home that serves different IPs for known hosts, such as having Google.com sent back the IP for playboy.com.

## Encrypted traffic (HTTPS)

Generally speaking, students should not be allowed to access encrypted websites. Encrypted traffic cannot be sniffed, and therefore, cannot be monitored. HTTPS traffic should only be allowed when necessary. Most websites a student needs to access are HTTP, not HTTPS. Due to the nature of HTTPS protocol, and the fact that encryption is an inherent security risk to your network, its use should be restricted.

Adding a security policy that encompasses a list of allowed secure sites will ensure that any HTTPS sites that are required are the only sites a student can go to.

## FTP

For the most part, students should not be using FTP. FTP is not HTTP or HTTPS so you cannot use URL filtering to restrict where they go. This can be controlled with destination IPs in the security policy. With a policy that specifically outlines which FTP addresses are allowed, all other will be blocked.

## Example security policies

Given these requirements, an example set of security policies could look like the following illustration. In a large setup, all the IPs for the students are treated by one of these four policies.

### Simple security policy setup

<input type="checkbox"/>	Seq. No.	ID	Source	Destination	Schedule	Service	Action	Status
<input type="checkbox"/>	1	2	<u>Student PCs</u>	<u>Allowed Websites</u>	always	HTTPS		
<input type="checkbox"/>	2	3	<u>Student PCs</u>	all	always	HTTP		
<input type="checkbox"/>	3	4	<u>Student PCs</u>	<u>Allowed DNS</u>	always	DNS		
<input type="checkbox"/>	4	5	<u>Student PCs</u>	<u>Allowed FTP</u>	always	FTP		
<input type="checkbox"/>	5		all	all	always	ANY		Implicit

The last policy in the list, included by default, is a deny policy. This adds to the potential of error that could end up allowing unwanted traffic to pass. The deny policy ensures that any traffic making it to this point is stopped. It can also help in further troubleshooting by viewing the logs for denied traffic.

With these policies in place, even before packet inspection occurs, the FortiGate, and the network are fairly secure. Should any of the UTM profiles fail, there is still a basic level of security.

## UTM security profiles

### Antivirus profiles

Antivirus screening should be enabled for any service you have enabled in the security policies. In the case above, HTTP, FTP, as well as POP3 and SMTP (assuming there is email access for students). There is not a virus scan option for HTTPS, because the content is encrypted. Generally speaking, most of the network traffic will be students surfing the web.

To configure antivirus profiles in the web-based manager, go to **Security Profiles > Antivirus**, or use the CLI commands under `config antivirus profile`.

### Web filtering

The actual filtering of URLs - sites and content - should be performed by FortiGuard. It is easier and websites are constantly being monitored, and new ones reviewed and added to the FortiGuard databases every day. The FortiGuard categories provide an extensive list of offensive, and non-productive sites.

As well, there are additional settings to include in a web filtering profile to best contain a student's web browsing.

- Web URL filtering should be enabled to set up exemptions for websites that are blocked or reasons other than category filtering. It also prevents the use of IP addresses to get around web filtering.
- Block invalid URLs - HTTPS only. This option inspects the HTTPS certificate and looks at the URL to ensure it's valid. It is common for proxy sites to create an HTTPS certificate with a garbage URL. If the site is legitimate, it should be set up correctly. If the site approach to security is to ignore it, then their security policy puts your network at risk and the site should be blocked.

Web filtering options are configured in the web-based manager by going to **Security Profiles > Web filter**, or in the CLI under `config webfilter profile`.

### Advanced options

There are a few Advanced options to consider for a web filtering profile:

- Enable **Provide details for blocked HTTP 4xx and 5xx errors**. Under normal circumstances there are exploits that can be used with 400 and 500 series messages to access the website. While most students probably won't know how to do this, there is no harm in being cautious. It only takes one.
- Enable **Rate Images by URL**. This option only works with Google images. It examines the URL that the images is stored at to get a rating on it, then blocks or allows the image based on the rating of the originating URL. It does not inspect the image contents. Most image search engines to a prefect and pass the images directly to the browser.
- Enable **Block HTTP redirects by rating**. An HTTP redirect is one method of getting around ratings. Go to one website that has an allowed rating, and it redirects to another website that may want blocked.

### Categories and Classifications

For the selection of what FortiGuard categories and classifications that should be blocked, that is purely based on the school system and its Internet information policy.

## Email Filtering

Other than specific teacher-led email inboxes, there is no reason why a student should be able to access, read or send personal email. Ports for POP3, SMTP and IMAP should not be opened in a security policies.

## IPS

The intrusion protection profiles should be used to ensure the student PCs are not vulnerable to attacks, nor do you want students making attacks. As well, IPS can do more than simple vulnerability scans. With a FortiGuard subscription, IPS signatures are pushed to the FortiGate unit. New signatures are released constantly for various intrusions as they are discovered.

FortiOS includes a number of predefined IPS sensors that you can enable by default. Selecting the `all_default` signature is a good place to start as it includes the major signatures.

To configure IPS sensors in the web-based manager, go to **Security Profiles > Intrusion Protection**, on the CLI use commands under `config ips sensor`.

## Application control

Application control uses IPS signatures to limit the use of instant messaging and peer-to-peer applications which can lead to possible infections on a student's PC. FortiOS includes a number of pre-defined application categories. To configure and maintain application control profiles in the web-based manager, go to **Security Profiles > Application Control**. In the CLI use commands under `config application list`.

Some applications to consider include proxies, botnets, toolbars and P2P applications.

## Logging

Turn on all logging - every option in this section should be enabled. This is not where you decide what you are going to log. It is simply defining what the UTM profiles can log.

Logging everything is a way to monitor traffic on the network, see what student's are utilizing the most, and locate any potential holes in your security plan. As well, keeping this information may help to prove negligence later in necessary.

## Replacement messages list

The replacement message list in **System > Config > Replacement Messages**.

The replacement messages list enables you to view and customize replacement messages. Use the expand arrow beside each type to display the replacement messages for that category. Select the **Edit** icon beside each replacement message to customize that message for your requirements.

Should you make a major error to the code, you can select the **Restore Default** to return to the original message and code base.

If you are viewing the replacement messages list in a VDOM, any messages that have been customized for that VDOM are displayed with a Reset icon that you can use to reset the replacement message to the global version.

For connections requiring authentication, the FortiGate unit uses HTTP to send an authentication disclaimer page for the user to accept before a security policy is in effect. Therefore, the user must initiate HTTP traffic first

in order to trigger the authentication disclaimer page. Once the disclaimer is accepted, the user can send whatever traffic is allowed by the security policy.

## Replacement message images

You can add images to replacement messages to:

- Disclaimer pages
- Login pages
- Declined disclaimer pages
- Login failed page
- Login challenge pages
- Keepalive pages

Image embedding is also available to the endpoint NAC download portal and recommendation portal replacement messages, as well as HTTP replacement messages.

Supported image formats are GIF, JPEG, TIFF and PNG. The maximum file size supported is 6000 bytes.

## Adding images to replacement messages

### To upload an image for use in a message

1. Go to **System > Config > Replacement Messages**.
2. Select **Manage Images** at the top of the page.
3. Select **Create New**.
4. Enter a **Name** for the image.
5. Select the **Content Type**.
6. Select **Browse** to locate the file and select **OK**.

The image that you include in a replacement message, must have the following html:

```
<img src=%%IMAGE: <config_image_name>%% size=<bytes> >
```

For example:

```
<img src=%%IMAGE: logo_hq%% size=4272>
```

## Modifying replacement messages

Replacement messages can be modified to include a message or content that suits your organization.

Use the expand arrows to view the replacement message list for a given category. Messages are in HTML format. To change a replacement message, go to **System > Config > Replacement Messages** select the replacement message that you want to modify. At the bottom pane of the window, you can see the message on one side and the HTML code on the other side. The message view changes in real-time as you change the content.

A list of common replacement messages appears in the main window. To see the entire list and all categories of replacement messages, in the upper-right corner of the window, select **Extended View**.

## Alert Mail replacement messages

The FortiGate unit adds the alert mail replacement messages listed in the following table to alert email messages sent to administrators. If you enable the option **Send alert email for logs based on severity**, whether or not replacement messages are sent by alert email depends on how you set the alert email in **Minimum log level**.

## Authentication replacement messages

The FortiGate unit uses the text of the authentication replacement messages for various user authentication HTML pages that are displayed when a user is required to authenticate because a security policy includes at least one identity-based policy that requires firewall users to authenticate.

These replacement message pages are for authentication using HTTP and HTTPS. You cannot customize the firewall authentication messages for FTP and Telnet.

The authentication login page and the authentication disclaimer include replacement tags and controls not found on other replacement messages.

Users see the authentication login page when they use a VPN or a security policy that requires authentication. You can customize this page in the same way as you modify other replacement messages.

There are some unique requirements for these replacement messages:

- The login page must be an HTML page containing a form with `ACTION="/"` and `METHOD="POST"`
- The form must contain the following hidden controls:
  - `<INPUT TYPE="hidden" NAME="%%MAGICID%%" VALUE="%%MAGICVAL%%">`
  - `<INPUT TYPE="hidden" NAME="%%STATEID%%" VALUE="%%STATEVAL%%">`
  - `<INPUT TYPE="hidden" NAME="%%REDIRID%%" VALUE="%%PROTURI%%">`
- The form must contain the following visible controls:
  - `<INPUT TYPE="text" NAME="%%USERNAMEID%%" size=25>`
  - `<INPUT TYPE="password" NAME="%%PASSWORDID%%" size=25>`

## Example

The following is an example of a simple authentication page that meets the requirements listed above.

```
<HTML><HEAD><TITLE>Firewall Authentication</TITLE></HEAD>
  <BODY><H4>You must authenticate to use this service.</H4>
  <FORM ACTION="/" method="post">
    <INPUT NAME="%%MAGICID%%" VALUE="%%MAGICVAL%%" TYPE="hidden">
  <TABLE ALIGN="center" BGCOLOR="#00cccc" BORDER="0"
    CELLPADDING="15" CELLSPACING="0" WIDTH="320"><TBODY>
  <TR><TH>Username:</TH>
    <TD><INPUT NAME="%%USERNAMEID%%" SIZE="25" TYPE="text"> </TD></TR>
  <TR><TH>Password:</TH>
    <TD><INPUT NAME="%%PASSWORDID%%" SIZE="25" TYPE="password"> </TD></TR>
  <TR><TD COLSPAN="2" ALIGN="center" BGCOLOR="#00cccc">
    <INPUT NAME="%%STATEID%%" VALUE="%%STATEVAL%%" TYPE="hidden">
    <INPUT NAME="%%REDIRID%%" VALUE="%%PROTURI%%" TYPE="hidden">
    <INPUT VALUE="Continue" TYPE="submit"> </TD></TR>
  </TBODY></TABLE></FORM></BODY></HTML>
```



## Captive Portal Default replacement messages

The Captive Portal Default replacement messages are used for wireless authentication only. You must have a VAP interface with the security set as captive portal to trigger these replacement messages.

## Device Detection Portal replacement message

The FortiGate unit displays the replacement message when the FortiGate unit cannot determine the type of BYOD or handheld device is used to connect the network.

## Email replacement messages

The FortiGate unit sends the mail replacement messages to email clients using IMAP, POP3, or SMTP when an event occurs such as antivirus blocking a file attached to an email that contains a virus. Email replacement messages are text messages.

If the FortiGate unit supports SSL content scanning and inspection these replacement messages can also be added to IMAPS, POP3S, and SMTPS email messages.

## Endpoint Control replacement message

The FortiGate unit displays the replacement message when the FortiClient Endpoint Security software is not installed or registered correctly with the FortiGate unit.

## FTP replacement messages

The FortiGate unit sends the FTP replacement messages listed in the table below to FTP clients when an event occurs such as antivirus blocking a file that contains a virus in an FTP session. FTP replacement messages are text messages.

## FortiGuard Web Filtering replacement messages

The FortiGate unit sends the FortiGuard Web Filtering replacement messages listed in the table to web browsers using the HTTP protocol when FortiGuard web filtering blocks a URL, provides details about blocked HTTP 4xx and 5xx errors, and for FortiGuard overrides. FortiGuard Web Filtering replacement messages are HTTP pages.

If the FortiGate unit supports SSL content scanning and inspection and if **Protocol Recognition > HTTPS Content Filtering Mode** is set to Deep Scan in the antivirus profile, these replacement messages can also replace web pages downloaded using the HTTPS protocol.

## HTTP replacement messages

The FortiGate unit sends the HTTP replacement messages listed in the following table to web browsers using the HTTP protocol when an event occurs such as antivirus blocking a file that contains a virus in an HTTP session. HTTP replacement messages are HTML pages.

If the FortiGate unit supports SSL content scanning and inspection, and if under HTTPS in the protocol option list has Enable Deep Scan enabled, these replacement messages can also replace web pages downloaded using the HTTPS protocol.

## IM replacement messages

The FortiGate unit sends the IM replacement messages listed in to IM clients using AIM, ICQ, MSN, or Yahoo! Messenger when an event occurs such as antivirus blocking a file attached to an email that contains a virus. IM replacement messages are text messages.

## NNTP replacement messages

The FortiGate unit sends the NNTP replacement messages listed in the following table to NNTP clients when an event occurs such as antivirus blocking a file attached to an NNTP message that contains a virus. NNTP replacement messages are text messages.

## Spam replacement messages

The FortiGate unit adds the Spam replacement messages listed in the following table to SMTP server responses if the email message is identified as spam and the spam action is discard. If the FortiGate unit supports SSL content scanning and inspection these replacement messages can also be added to SMTPS server responses.

## NAC quarantine replacement messages

The page that is displayed for the user depends on whether NAC quarantine blocked the user because a virus was found, a DoS sensor detected an attack, an IPS sensor detected an attack, or a DLP rule with action set to **Quarantine IP address** or **Quarantine Interface** matched a session from the user.

The default messages inform the user of why they are seeing this page and recommend they contact the system administrator. You can customize the pages as required, for example to include an email address or other contact information or if applicable a note about how long the user can expect to be blocked.

## SSL VPN replacement message

The SSL VPN login replacement message is an HTML replacement message that formats the FortiGate SSL VPN portal login page. You can customize this replacement message according to your organization's needs. The page is linked to FortiGate functionality and you must construct it according to the following guidelines to ensure that it will work.

- The login page must be an HTML page containing a form with `ACTION="%%SSL_ACT%%"` and `METHOD="%%SSL_METHOD%%"`
- The form must contain the `%%SSL_LOGIN%%` tag to provide the login form.
- The form must contain the `%%SSL_HIDDEN%%` tag.

## Web Proxy replacement messages

The FortiGate unit sends Web Proxy replacement messages listed in the table below when a web proxy event occurs that is detected and matches the web proxy configuration. These replacement messages are web pages that appear within your web browser.

The following web proxy replacement messages require an identity-based security policy so that the web proxy is successful. You can also enable FTP-over-HTTP by selecting the **FTP** option in **System > Network > Explicit Proxy**.

## Traffic quota control replacement messages

When user traffic is going through the FortiGate unit and it is blocked by traffic shaping quota controls, users see the **Traffic shaper block message** or the **Per IP traffic shaper block message** when they attempt to connect through the FortiGate unit using HTTP.

The traffic quota HTTP pages should contain the `%%QUOTA_INFO%%` tag to display information about the traffic shaping quota setting that is blocking the user.

## MM1 replacement messages

MM1 replacement messages are sent when, during MMS content scanning, FortiOS Carrier detects, for example a virus, using the MMS profile.

You must have **Remove Blocked** selected within the MMS profile if you want to remove the content that is intercepted during MMS scanning on the FortiGate unit.

## MM3 replacement messages

MM3 replacement messages are sent when, during MMS content scanning, FortiOS Carrier detects, for example a virus, using the MMS profile.

You must have **Remove Blocked** selected within the MMS profile if you want to remove the content that is intercepted during MMS scanning on the unit.

## MM4 replacement messages

MM4 replacement messages are sent when, during MMS content scanning, FortiOS Carrier detects, for example a virus, using the MMS profile.

## MM7 replacement messages

MM7 replacement messages are sent when, during MMS content scanning, FortiOS Carrier detects, for example a virus, using the MMS profile.

## MMS replacement messages

The MMS replacement message is sent when a section of an MMS message has been replaced because it contains a blocked file. This replacement message is in HTML format.

The message text is:

```
<HTML><BODY>This section of the message has been replaced because it contained a blocked  
file</BODY></HTML>
```

## Replacement message groups

Replacement message groups enable you to view common messages in groups for large carriers. Message groups can be configured by going to **Config > Replacement Message Group**.

Using the defined groups, you can manage specific replacement messages from a single location, rather than searching through the entire replacement message list.

If you enable virtual domains (VDOMs) on the FortiGate unit, replacement message groups are configured separately for each virtual domain. Each virtual domain has its own default replacement message group, configured from **System > Config > Replacement Messages Group**.

When you modify a message in a replacement message group, a Reset icon appears beside the message in the group. You can select this Reset icon to reset the message in the replacement message group to the default version.

All MM1/4/7 notification messages for FortiOS Carrier (and MM1 retrieve-conf messages) can contain a SMIL layer and all MM4 notification messages can contain an HTML layer in the message. These layers can be used to brand messages by using logos uploaded to the FortiGate unit via the 'Manage Images' link found on the replacement message group configuration page.

## Disk

To view the status and storage information of the local disk on your FortiGate unit, go to **System > Config > Advanced**. The **Disk** menu appears only on FortiGate units with an internal hard or flash disk.

### Formatting the disk

The internal disk of the FortiGate unit (if available) can be formatted by going to **System > Config > Advanced** and selecting **Format**.

Formatting the disk will erase all data on it, including databases for antivirus and IPS; logs, quarantine files, and WAN optimization caches. The FortiGate unit requires a reboot once the disk has been formatted.

### Setting space quotas

If the FortiGate unit has an internal hard or flash disk, you can allocate the space on the disk for specific logging and archiving, and WAN optimization. By default, the space is used on an as required basis. As such, a disk can fill up with basic disk logging, leaving less potential space for quarantine.

By going to **System > Config > Advanced**, you can select the **Edit** icon for **Logging and Archiving** and **WAN Optimization & Web Cache** and define the amount of space each log, archive and WAN optimization has on the disk.

## CLI Scripts

To upload bulk CLI commands and scripts, go to **System > Config > Advanced**.

Scripts are text files containing CLI command sequences. Scripts can be used to deploy identical configurations to many devices. For example, if all of your devices use identical security policies, you can enter the commands required to create the security policies in a script, and then deploy the script to all the devices which should use those same settings.

Use a text editor such as Notepad or other application that creates simple text files. Enter the commands in sequence, with each line as one command, similar to examples throughout the FortiOS documentation set.

If you are using a FortiGate unit that is not remotely managed by a FortiManager unit or the FortiGuard Analysis and Management Service, the scripts you upload are executed and discarded. If you want to execute a script more than once, you must keep a copy on your management PC.

If your FortiGate unit is configured to use a FortiManager unit, you can upload your scripts to the FortiManager unit, and run them from any FortiGate unit configured to use the FortiManager unit. If you upload a script directly to a FortiGate unit, it is executed and discarded.

If your FortiGate unit is configured to use FortiGuard Analysis and Management Service, scripts you upload are executed and stored. You can run uploaded scripts from any FortiGate unit configured with your FortiGuard Analysis and Management Service account. The uploaded script files appear on the FortiGuard Analysis and Management Service portal website.

## Uploading script files

After you have created a script file, you can then upload it through **System > Config > Advanced**. When a script is uploaded, it is automatically executed.

Commands that require the FortiGate unit to reboot when entered in the command line will also force a reboot if included in a script.

### To execute a script

1. Go to **System > Config > Advanced**.
2. Verify that **Upload Bulk CLI Command File** is selected.
3. Select **Browse** to locate the script file.
4. Select **Apply**.

If the FortiGate unit is not configured for remote management, or if it is configured to use a FortiManager unit, uploaded scripts are discarded after execution. Save script files to your management PC if you want to execute them again later.

If the FortiGate unit is configured to use the FortiGuard Analysis and Management Service, the script file is saved to the remote server for later reuse. You can view the script or run it from the FortiGuard Analysis and Management Service portal website.

## Rejecting PING requests

The factory default configuration of your FortiGate unit allows the default external interface to respond to ping requests. Depending on the model of your FortiGate unit the actual name of this interface will vary. For the most secure operation, you should change the configuration of the external interface so that it does not respond to ping requests. Not responding to ping requests makes it more difficult for a potential attacker to detect your FortiGate unit from the Internet. One such potential threat are Denial of Service (DoS) attacks.

A FortiGate unit responds to ping requests if ping administrative access is enabled for that interface.

**To disable ping administrative access - web-based manager**

1. Go to **System > Network > Interface**.
2. Choose the external interface and select **Edit**.
3. Clear the **Ping Administrative Access** check box.
4. Select **OK**.

In the CLI, when setting the allowaccess settings, by selecting the access types and not including the PING option, that option is then not selected. In this example, only HTTPS is selected.

**To disable ping administrative access - CLI**

```
config system interface
  edit external
    set allowaccess https
  end
```

## Opening TCP 113

Although seemingly contrary to conventional wisdom of closing ports from hackers, this port, which is used for ident requests, should be opened.

Port 113 initially was used as an authentication port, and later defined as an identification port (see RFC 1413). Some servers may still use this port to help in identifying users or other servers and establish a connection. Because port 113 receives a lot of unsolicited traffic, many routers, including on the FortiGate unit, close this port.

The issue arises in that unsolicited requests are stopped by the FortiGate unit, which will send a response saying that the port is closed. In doing so, it also lets the requesting server know there is a device at the given address, and thus announcing its presence. By enabling traffic on port 113, requests will travel to this port, and will most likely, be ignored and never responded to.

By default, the ident port is closed. To open it, use the following CLI commands:

```
config system interface
  edit <port_name>
    set ident_accept enable
  end
```

You could also further use port forwarding to send the traffic to a non-existent IP address and thus never have a response packet sent.

## Obfuscate HTTP responses

The FortiGate unit can obfuscate the HTTP responses from the FortiGate admin GUI and SSL VPN servers. By default this option is not enabled. To obfuscate HTTP headers, use the following CLI command:

```
config system global
  set http-obfuscate {none | header-only | modified | no-error}
end
```

**Where:**

`none` — do not hide the FortiGate web server identity.

`header-only` — hides the HTTP server banner.

`modified` — provides modified error responses.

`no-error` — suppresses error responses.



High Performance Network Security



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